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VARIOUS BRITISH HOSPITAL SURGEONS

EDITED BY

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VOL. I.

ABDOMEN—LYMPH-SCROTUM

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PREFACE

The Dictionary of Practical Surgery will, it is hoped, supply a want in the library of the busy practitioner, who necessarily often meets with cases of surgical disease or injury on which he desires to have immediate information as to diagnosis and treatment. With the view of assisting him, as far as is possible for a book to do so, in arriving at a correct diagnosis (on which suitable treatment must of course depend), a series of articles on the diagnosis of the injuries and diseases of the several regions of the body has been introduced, as well as general articles on Deafness, the Eye, Skin Diseases, &c. The surgical affections will be found fully described under their proper names, in alphabetical order; or when it has been found more convenient to group together a series of diseases of one organ—as, *e.g.*, of the Breast—cross-references have been given, the name of the separate article referred to being printed in small capitals.

The subjects are treated of, so far as is practicable, in the following order:—1, Cause; 2, Pathology; 3, Symptoms and Diagnosis; 4, Treatment; 5, Prognosis. Each writer has signed his articles, and is responsible for the statements contained in them; but the Editor has, of course, exercised a general supervision, and has endeavoured to prevent the promulgation of crude theories, or the inculcation of doubtful practices. At the same time, he has not attempted to reconcile the views of surgeons who may happen to differ on points of practice; nor does he endorse every statement put forth by the various writers. It was impossible to illustrate the Dictionary, both on account of the extra space which would have been occupied, and also on account of the time necessary for the production of original woodcuts. The aim of the Editor has been to produce a compendium of the practice of British Surgery of the present day, and, as only two years will have elapsed between the first planning of the Dictionary and its publication, that object will have been fairly attained.

At the end of the second volume will be found a General Index of Subjects, which will, it is hoped, greatly facilitate reference to the several articles bearing on any special subject, and also an Index of Authors, giving the contributions of each. The Editor has to thank these gentlemen for their valuable contributions and for the promptitude with which they have completed their labours.

The Editor has also to offer his best thanks to Mr. W. Johnson Smith, who has acted as Sub-editor of the whole work; and to Dr. Robert Liveing and Mr. John Tweedy, who have respectively supervised the articles on Diseases of the Skin and Affections of the Eye, for their valuable co-operation.

Cavendish Square: *January* 1886.

DICTIONARY

OF

PRACTICAL SURGERY

ABDOMEN, Injuries of the.—All abdominal injuries are attended by more or less shock; if this be of a persistent or relapsing nature, grave internal mischief is denoted, although authenticated cases are on record in which a blow on the epigastric region has resulted in death, due solely to shock. Continuous pain, which becomes most intense at one point, and radiates over the abdomen from this, is an unfavourable sign. Persistent vomiting should be regarded as a symptom pointing to visceral injury. In all cases the abdomen must be very carefully examined, and it is specially desirable to ascertain if the bladder be intact. Purgative medicine should always be avoided until the exact injury has been diagnosed.

CONTUSION OF THE ABDOMINAL PARIETES. This injury occurs both without and with rupture of some abdominal textures and underlying viscera.

Simple contusions may be either cutaneous or musculo-cutaneous.

The *cutaneous* ones are caused by slight blows, falls, kicks, or wheels of heavy vehicles.

The *symptoms* depend on the extent of the injury. Generally there will exist feelings of faintness and sickness, anxious face, and diminution in the warmth of the extremities; pain in the region of the injury, increased by movement; more or less pain during respiration, followed by ecchymosis of the skin over the affected area.

Treatment.—Rest in the horizontal position. Stimulants in small doses to counteract the shock; anodynes to relieve pain. Locally, warm poultices or ice. If blood has been extravasated in small quantity it is apt to give a peculiar crepitant feeling to the hand of the surgeon, if in large quantity it may be necessary to aspirate the fluid portion.

CONTUSION WITH MUSCULAR RUPTURE. This may exist as a small tear of one muscle, most frequently the rectus, or the whole thickness of the muscular wall of the abdomen may be rent.

Causes.—Passage of wheels over the surface of the abdomen, and buffer-accidents.

Symptoms.—Those of shock; some pain in affected region, increased by movement: if the patient be seen directly after the receipt of the injury, separation of the muscular fibres may be detected; but this is often difficult to discern, as the lesion is quickly followed by extravasation of blood and tumefaction. If the whole thickness of the muscular wall of the abdomen is involved, the symptoms will be more marked, and even resemble those of internal hæmorrhage, viz. pale and anxious face, extreme prostration, general restlessness, pulse small and feeble, skin cold and clammy.

Prognosis.—This depends upon the degree of rupture. If the whole muscular wall be torn, death may take place from shock. If recovery ensues, the formation of a ventral hernia must be looked for.

Treatment.—Rest in the horizonal position. Stimulants at first in small doses. Locally, hot fomentations, ice, or Leiter's coil; opium, or some of its preparations, by the mouth, rectum, or subcutaneously to relieve pain. The abdomen should be supported by a flannel bandage, a suitable belt, or by strapping if the rupture be small. Any intestinal protrusion must be returned, and a firm dry compress applied over it. Should symptoms of strangulation ensue, the opening must be exposed by incision, the bowel returned, all blood-clot removed, and the parietal wound closed by silk sutures.

Rupture of the Stomach without External Wound.—*Causes.*—Direct violence applied to the epigastric region.

Symptoms. — Marked collapse, pallid skin, clammy sweats, pulse small and weak, tenderness over the whole abdomen, most marked in the epigastric region; vomiting of blood and matter resembling coffee-grounds may or may not be present.

Prognosis.—Unfavourable: death always taking place within twelve hours of the receipt of the injury.

Situation.—Any portion of the stomach may be affected, but in the cases recorded the majority were ruptured near the pyloric extremity, and on the great curvature. All the coats of the viscus may be torn, or the mucous and peritoneal may suffer, and the muscular be left intact.

Treatment.—Rest in bed, warmth, ether subcutaneously for shock, and morphia administered in the same manner to allay pain. Stimulant and nutrient peptonised enemata should be given, and nothing by the mouth.

Rupture of the Intestine from External Violence without Wound of the Parietes.—*Causes.*—Force applied suddenly to the front and sides of the abdomen, such as that caused by the wheels of a vehicle, blows or kicks of a man or animal.

Symptoms.—Those of shock: the face pale and anxious-looking; restlessness; tympanites following almost immediately the receipt of the injury. The pain in the abdomen is great, and rapidly diffuses itself all over the belly. As peritonitis is developed, the muscles of the abdominal wall become tense and unyielding. Vomiting is constant and distressing, and usually commences immediately after the injury has been inflicted. Any food in the stomach is first ejected, then grumous-looking fluid, finally stercoraceous matter. The tongue varies, being generally dry, coated and red at the edges. Intense thirst is present. The respiration is thoracic, rapid and shallow. The pulse varies—at first feeble and somewhat slow, then rapid and thready.

Parts affected.—Any portion of the intestinal tract, from the stomach to the rectum, may be injured; but the small intestines, jejunum and ileum, are most frequently lacerated. The size of the wound varies greatly.

Prognosis. — Unfavourable, as death generally ensues in forty-eight hours, the later symptoms being those of extreme prostration. A chronic circumscribed peritonitis may result, ending in absorption or abscess, and recovery. Such cases, however, are the exception, and not the rule.

Treatment.—Rest in bed, and the application of artificial heat to the extremities. Morphia should be administered subcutaneously every two hours, if needed, until the acuteness of the pain is lulled. Anodyne suppositories may also be used, but are not so efficacious in relieving the pain. For the intense thirst, ice may be given to suck, or iced water in teaspoonful doses. If this be ejected by the stomach, warm water in the same quantities may be tried.

Locally. — Hot fomentations, or light linseed poultices, alone or with laudanum, may be applied. A cradle should be employed to keep off the weight of the bedclothes.

When the diagnosis has been made as certain as possible, and the symptoms are hourly becoming more urgent, some surgeons might feel justified in opening the abdomen to seek the injured intestine. *See* Laparotomy.

Emphysema of the Abdominal Wall. This condition, as the result of injury, is a sign of rupture of the underlying intestine, and an escape of flatus into the sub-peritoneal tissues. A puffy, doughy, crepitant swelling, usually commencing in the flank, slowly creeps up the abdominal wall, which may even become resonant on percussion. The air is generally re-absorbed without requiring any puncture.

Wounds of the Abdominal Walls.—The various kinds of wounds of the walls of the abdomen may be: 1. incised; 2. punctured; 3. lacerated and contused.

1. *Incised wounds* are produced by sharp cutting instruments, glass, and china, and may extend to any depth, down to the peritoneum. When the direction of the wound is transverse, the consequent gaping is apt to be more marked than when the direction is vertical. Unless some branch of the internal mammary or epigastric arteries is severed, the hæmorrhage caused is not great, but there is most risk of bleeding when the injury is in the iliac region.

2. *Punctured wounds* are of a more dangerous nature, as their exact extent is not always evident, and probing and other manipulations should be avoided, or at any rate but very gently employed. Suppuration is apt to follow the infliction of this type of wound, which, spreading in the cellular planes between the muscles, may ultimately set up peritonitis.

3. *Lacerated and Contused Wounds.*—These, clinically, may be classified together; they are caused by blunt instruments, the horns and teeth of animals, and firearms. The injured textures are prone to slough, and the severity of the symptoms will depend upon the depth of the injury. Gunshot wounds, which are the result of spent balls, generally suppurate extensively; healing takes place slowly.

Treatment.—The immediate treatment of all varieties of wounds of the walls of the abdomen consists in the cleansing of the wound and the staunching of the hæmorrhage. The former should be accomplished with clean warm water, or an antiseptic solution, such as carbolic acid (1 to 40) or corrosive sublimate (1 to 1,000). If the bleeding be only slight, it may be controlled by a pad of lint or a piece of sponge; if more profuse, and a spurting artery is visible, the vessel divided must be secured, either with a catgut ligature or by torsion. Should the precise bleeding point be obscured, the wound must be cautiously enlarged until it can be brought into view, and then secured.

If the wound be an incised one, the edges should be approximated by sutures passing deeply through all the divided tissues, and a suitable drainage-tube be inserted at the lower angle of the wound. In punctured and the other variety of wounds of the abdominal parietes, no attempt at closure should be made.

The subsequent dressing may be Listerian, or of lint steeped in carbolic or terebene oil (1 in 10), boracic glycerine (1 in 4), or an aqueous solution of carbolic or boracic acid, or corrosive sublimate (1 in 2,000); and either wood-wool pads or those composed of an antiseptic absorbent cotton-wool should be placed over and secured by a broad bandage firmly applied, to counteract the tendency to ventral hernia. As far as possible, perfect rest should be enjoined, and all tension taken off the abdominal muscles by bending the trunk in a forward direction.

Wounds of the Abdomen with Protrusion of Uninjured Viscera. — The escape of the contents of the abdominal cavity is relatively much greater than the size of the wound, and a larger protrusion results from incised and lacerated wounds than from punctured ones. Omentum, intestines, stomach, bladder, and liver may all protrude, but the omentum and small intestines do so most frequently.

Prognosis.—In all cases of wounds of the abdomen with visceral protrusion, the outlook is serious, as the consequent shock is severe, and peritonitis and septicæmia are very frequent complications, causing a fatal termination.

Treatment.—Before entering into details of the treatment of the various viscera when projecting through an opening in the abdominal walls, a few preliminary points with reference to the treatment of all injuries of the abdomen should be stated. A very important matter to be attended to is, as far as possible to enjoin absolute rest for the viscera; for this purpose, but little nourishment should be given for the first three days except in the form of a little milk and water. Pain should be allayed by morphia given subcutaneously or by suppository. Efforts at coughing, straining, or vomiting, should be avoided; if the last-named symptom be present, the patient should be fed by pancreatised enemata, and nothing but small quantities of warm water given by the mouth.

Locally.—All hæmorrhage should be stopped, and care taken that at the first dressing the peritoneum be left clean and dry. No irritating antiseptic should be applied to the peritoneum, or this end may be defeated. Especial care should be taken that all sponges and fingers are aseptic and are used warm. The protruding viscera should be handled as little as possible, and while exposed should be covered with a flat warm sponge.

Protrusion of the Omentum.—A careful examination must be made as soon after the injury as possible, to see that no coil of the intestines is concealed. This having been demonstrated, the exact treatment will depend upon the existing condition of the hernia. The injury being recent and the omentum sound and reducible, the protruding mass is to be cleaned with an aseptic sponge and warm water and returned gently into the abdomen. The wound is to be closed with an interrupted or continuous suture, including the entire thickness of the abdominal wall.

Should the omentum be irreducible, congested or strangulated, it must be left in position, plugging the wound. A compress of antiseptic gauze, absorbent wool, wood wool, or lint soaked in boracic glycerine, terebene oil, or warm water, should be applied and kept in position by means of a broad bandage. If no urgent symptoms supervene, the dressings should be left *in situ* for several days, and when adhesions have been formed, a double ligature should be passed through the protruding fatty mass, just above the level of the skin, and it should be firmly tied in two halves. The portion of omentum projecting above the ligature should be gently removed with the knife or scissors. That part left plugging the wound will subsequently granulate, and the opening close.

If, when first seen by the surgeon, the omentum be inflamed, adherent, suppurating, or gangrenous, the mass should be ligatured and removed at once.

PROTRUSION OF INTESTINE.—The protrusion being recent, an anæsthetic should be at once given, and the projecting coil protected by a sponge wrung out in hot water. The gut having been gently and carefully cleaned, it should be returned into the abdominal cavity by means of the thumb and forefinger of one hand and the pressure of the warm sponge with the other. The intestine should be followed into the peritoneal cavity, in order that perfect reduction may be effected, and that it may not be merely pressed back between the peritoneum and the abdominal wall.

Reduction having been accomplished, a piece of warm flat sponge should be passed in at the opening, and left overlying the returned gut, until the closure of the external wound is all but completed: it should then be withdrawn. The silk sutures for closing the abdomen may be either interrupted or continuous, and should include the peritoneum and all textures composing the abdominal wall. Some surgeons prefer to close the peritoneum first, by means of a continuous catgut suture, and afterwards the wound in the parietes. Pads of dry lint, cotton wool, or wood wool should then be applied, and maintained in position by strapping and a broad flannel bandage.

Should, however, the protruding mass of intestine be large and irreducible through the original wound, either this must be sufficiently enlarged in an upward or downward direction, the surgeon's forefinger being introduced into the abdominal cavity to act as a guide, until the necessary reduction can be accomplished; or the protruding coil may be aspirated or punctured with a small needle, and emptied of its distending flatus. Reduction in a collapsed state may then be attempted.

If the protruded mass be already inflamed or deeply congested, it should still be returned into the abdomen, but the external opening must not be quite closed at its lower angle, to allow of the insertion of a glass drainage-tube for at least twenty-four hours. Should the intestine be strangulated and gangrenous, or very doubtful-looking, the opening in the abdominal walls should be enlarged to relieve the constriction, and no attempt should be made at reduction, but the affected coil be left *in situ* and watched. In such cases, the formation of an artificial anus offers the most hopeful prognosis. If the jejunum be the injured part, and a false anus supervenes, death will eventually take place from inanition. The gangrenous mass may either be incised or left to slough. The dressing should be warm charcoal and linseed poultices, or antiseptics such as boracic acid, carbolic and terebene oils, and iodoform in powder.

WOUNDS OF HOLLOW VISCERA.—These are very grave injuries, and the prognosis is unfavourable on account of the extreme shock which is occasioned, the extravasation of the contents of the intestine, and the subsequent peritonitis. The hollow viscera may be injured by incised, punctured, lacerated, or gunshot wounds, and the coiling of the intestines renders them liable to be the seat of multiple wounds. The relative frequency of the seat of injury is as follows:—1. Small intestine. 2. Transverse colon. 3. Stomach. 4. Ascending and descending colon.

Wounds of the intestines may occur (1) with or (2) without protrusion, and the extent of the injury will vary from a mere prick or wound a few lines long, to complete severance of the tube. When a mere puncture occurs, the mucous coat will often prolapse, and plug the wound in the muscular and peritoneal coats. When the small intestine is the portion of the tube injured, the prognosis is more unfavourable than when the colon is so affected, owing to its contents being more liquid, the covering of the peritoneum more complete, and the tube less fixed in position.

Symptoms.—Severe and prolonged collapse, pale and anxious countenance, feeble quick pulse, cold and clammy extremities, vomiting, thirst, great local pain, and the escape of flatus and fæces through the wound. Peritonitis speedily sets in.

Treatment.—The first step in all varieties of wounds of the hollow viscera is to stop hæmorrhage, and to ensure rest in the horizontal position. Morphia or opium should be administered for the pain, and all solid nourishment should be abstained from for three days, the patient merely sucking ice, or taking teaspoonfuls of warm or cold water at intervals. If possible, the bowels should be confined for ten days. If the large gut be intact, pancreatised enemata may be administered for purposes of nourishment.

Wound with Protrusion.—When the wound is a mere prick, the peritoneal cavity should be carefully sponged out, the bowel returned, and the wound closed.

If the wound be a few lines long, the intestinal tube should be held on each side of the opening with forceps, and a catgut ligature applied. The intestine should then be returned into the abdomen, and the wound closed. The wound being large, and the coats of the intestine cleanly incised, a continuous carbolised or catgut suture should be applied, as far as possible avoiding the mucous coat, and replacement effected, with closure of the wound.

Should the wound of the gut be lacerated, the intestine should be sewn to the skin of the parietal wound, and an artificial anus constituted. When the intestine is cut right across, an endeavour may be made to close the wound by a continuous silk ligature, applied with great care, to bring similar textures into apposition, or an artificial anus may be made. In our present state of knowledge, the latter procedure seems to offer the best prognosis.

Without Protrusion.—The wound in the wall of the abdomen must be carefully enlarged, and the opening in the viscera looked for. If found, it must be treated according to its dimensions. (*See* above.) Should the wound not be discovered, the peritoneal cavity must be thoroughly washed out, and a large glass drainage-tube passed down into the pelvis, the parietal opening being closed, except at the lower end.

THOMAS F. CHAVASSE.

ABDOMINAL ANEURISM. — The abdominal aorta is subject to degenerative changes which rob the vessel of its elasticity, and render it liable to rupture of its coats and the formation of a false aneurism; or the elastic coat may alone be at fault, and a permanent dilatation of all the coats of the vessel may result, constituting a true aneurism in the affected part of the vessel. The existence of true aneurism of the abdominal aorta is, however, a very rare occurrence.

In this vessel another factor comes into play in producing aneurism, viz. sudden or violent exertion of the trunk of the body. This often leads to the formation of an aneurism in a tolerably healthy vessel, a fact of importance in considering the treatment of the disease, as it is in these cases, resulting from violent straining of the vessel, that we may look for the best results in adopting treatment by pressure.

Most of the aneurisms in this vessel are sacculated (60 per cent.), and vary in size, from the smallest pouch-like depression, to sacs of a size as large as the vessel and the surrounding parts will permit. In these large aneurisms the internal and middle coats of the vessel almost disappear, or exist as mere calcareous or atheromatous patches, while the external coat is often much increased in thickness, and supported by adherent organs. On the other hand, the external coat may become attenuated by the pressure of surrounding parts. Thus, either absorption of the coats of the vessel, and erosion of the surrounding parts, or adhesion and thickening of its walls, may be going on in an aneurism; and its duration will be largely determined by the prevalence of the one or the other of these processes. The sac of the aneurism may be almost filled by coagula of blood and fibrin, or it may be almost empty. This difference, to a large extent, depends on the size of the orifice of communication between the sac and the vessel, by which the volume of the current of blood in the sac is regulated. This is a matter of some importance in enabling us to form an opinion of the treatment to be used. A globular aneurism, forming a distinct and somewhat movable tumour, is likely to have a small orifice, and is favourable for the deposition of blood-clot or fibrin; and in it the current can be most effectually cut off by pressure when an aneurism enlarges.

While in most cases aneurisms of the abdominal aorta tend to increase in size, and eventually to burst, there are not a few cases on record in which spontaneous cure has occurred. Hodgson related the case of a small aneurism which had hollowed out the body of a vertebra by pressure, and had then become completely filled up by the layers of fibrin. Again, a sacculated aneurism has been found doubled over on its aperture of communication with the aorta, and thus cured by its own pressure. Holmes quotes a case of spontaneous cure of an aneurism of the cœliac axis, which he discovered in the body of a man who had never complained of any symptoms of aneurism. The sac was obliterated, except a channel in the centre filled with soft clot, through which the circulation must have been maintained in the large branches of the cœliac axis. He refers, also, to the curious preparation in the Hunterian Museum of the abdominal aorta of a jaguar with an aneurism nearly consolidated.

Seat of the Disease.—The disease may occur at any point in the circumference of the vessel, and the late Dr. Sibson has shown that it springs just as often from the front of the vessel as from its posterior aspect. It may be as high as the pillars of the diaphragm, or it may occupy the origin of the cœliac axis, or, more frequently, it lies on a level with, or below, the renal arteries. It occurs less frequently in the lower third of the vessel, generally involving the inferior mesenteric artery, if the sac is large. The arteries involved in the aneurismal pouch are either dilated or obliterated, the former by the expansion of the walls of the vessel, the latter by pressure of the tumour as the vessel passes over it, or by plugging with fibrin from within. Pressure on the surrounding organs often results as the aneurism enlarges, leading to jaundice, from pressure on the liver or bile-ducts, or to nausea from pressure on the stomach and duodenum; or to dysphagia from pressure on the œsophagus, or to uræmia, in rare cases, from pressure on the kidneys or renal vessels. Sometimes organs are pushed out of their natural position by abdominal aneurisms, e.g. the liver may be pushed forward, or the left kidney pushed to the opposite side.

The vena cava is seldom compressed, and on this account dropsy of the extremities and enlargement of the superficial veins are rare in abdominal aneurism. The colon may be compressed, so as to lead to obstruction of the bowels.

An aneurism which springs from the front of the aorta presses on the ganglia and plexuses of the sympathetic system, leading to pain in the epigastric region, for the most part. An aneurism which springs from the posterior aspect of the aorta presses on the spinal nerves, leading to pain (chiefly paroxysmal and radiating) in the back and loins. These posterior aneurisms produce erosion of the vertebræ, but statistics show that the characteristic pain may be present without erosion, and erosion without the characteristic pain, so that no relation exists between pain and erosion. The pains doubtless arise from pressure on the spinal nerves.

Abdominal aneurisms are liable to rupture; and the formation of a diffuse aneurism, when bleeding occurs into the areolar tissue, is the result. Rupture may also occur on the surface of the skin or mucous membrane, or into the peritoneal cavity.

The Causation of the Disease.—The predisposing cause is degeneration of the coats of the vessel. The chief exciting cause is strain produced by over-exertion. Advanced age, syphilis, intemperance, and all other influences which impair the constitution, lead to these degenerative changes of the tissues which favour aneurism. In the writer's opinion, syphilis is most often the principal factor in this disease. The occupations which seem to predispose to the disease are all of a laborious nature—smiths, strikers, excavators, navvies, porters, paviours, being its victims. Where the disease occurs apart from great bodily exertion, we may infer the existence of considerable degeneration of the vessel.

Symptoms.—Pain is the earliest and most prominent symptom—sometimes continuous, with occasional paroxysms of increased severity; at other times, almost entirely paroxysmal or intermittent. It occurs in the epigastrium or hypogastrium, and in the back or loins; in the former cases it indicates aneurism of the front of the aorta, in the latter it indicates a posterior aneurism. The pain radiates around the trunk, down the extremities, and into the testicle. It varies in character, as indicated by the words turning, catching, twisting, lancinating, or boring. Often a dull pain when continuous, it becomes sharp and severe when paroxysmal. A pulsating tumour is also a very prominent symptom. The pulsation is generally felt equally in all directions, and the tumour is felt to expand under the hand with each pulsation of the aorta. A double shock is sometimes felt when the tumour is so near the heart as to receive an impulse from it.

The tumour is generally fixed, its non-mobility with the diaphragm being highly characteristic. The pulsation may be felt in the epigastrium, a little to the left of the middle line, or it may be covered by the margins of the left ribs. More rarely it inclines to the right, pushing forward the liver with each impulse. It sometimes lies so deeply in this region as to be barely perceptible on deep pressure.

The *diagnosis* in these cases is rendered extremely difficult, especially when we remember how vividly a nervous pulsation of the aorta will simulate an aneurism. In the latter case, we have an aneurism with scarcely perceptible pulsation, and in the former we have violent pulsation of the aorta without an aneurism. The tumour may appear in the loin or in the groin, and may simulate a lumbar abscess in the one case, or a psoas abscess in the other. It may also be mistaken for disease of the spleen and kidney. Let it be specially noted that an aneurism may exist where no tumour at all can be felt.

The pulsating tumour may vary in size, shape, and consistency to almost any extent, so that no valuable indication can be derived from these points, but it possesses a special characteristic in the *bellows-murmur*, which occurs in a large number of cases. If this murmur be systolic in time, and be distinct from any cardiac murmur which may exist, it becomes a very reliable sign of the disease. In all doubtful cases the stethoscope should be applied to the left vertebral groove, as well as in front, since a murmur audible in the back is strong evidence of the disease.

Dyspnœa from pressure on the diaphragm, cough from the same cause, dysphagia from pressure on the œsophagus, nausea, spasmodic flatulent pain and constipation from pressure, are secondary symptoms; as also are numbness or coldness of the legs, formication, pricking pain and loss of power in the lower extremities. On the other hand, ascites and anasarca are exceedingly rare in this disease. It must not be forgotten that all these symptoms may subside for a time, and apparent recovery may take place, until sudden death reveals the secret existence of the disease. In most cases, if not cured by treatment, the patient passes through a period of increasing pain, restlessness, insomnia, emaciation and exhaustion, until rupture puts an end to his sufferings.

Let it be noted that the following symptoms are rare in aneurism, and contra-indicate the presence of the disease:—Rapidity of pulse, œdema of the lower extremities, ascites, enlargement of the superficial abdominal veins; the presence of pus, mucus, blood, or albumen in the urine, jaundice, mobility of tumour without murmur, the malignant cachexia of cancer, and the deposits of cancer or tubercle.

The duration of the disease varies from a few months to many years. After the first appearance of prominent symptoms, the patient rarely lives more than eighteen months, and generally dies within three months, unless he is rescued by surgical or medical treatment.

Death may occur from exhaustion, pressure on vital parts, or hæmorrhage. The hæmorrhage may be suddenly fatal, or it may let life ebb out in a gentle stream, and the patient may get relief of all his symptoms before he dies. When the bleeding occurs into the peritoneum death is sudden, and when into the stomach, lungs, or bowels, blood will often be discharged from these cavities before death. The occurrence of bleeding is often followed by the formation of a soft, semi-fluctuating tumour in one of the abdominal regions, indicating the formation of a diffuse aneurism.

Treatment.—The treatment of abdominal aneurisms has come within the range of practical surgery during the last twenty years. Previously, these diseases were regarded as beyond the pale of surgical treatment, and the efforts to cure them consisted mainly in a system of resting the parts; while the circulation of blood was reduced by medicines and diet to a level which was supposed to be conducive to the formation of layers of fibrin, by which the aneurismal sac might be filled up.

Since the year 1864 a considerable number of cases have been cured by the application of the rapid-pressure treatment—i.e. by applying pressure to the aorta, above the seat of the aneurism, so as to stop the circulation of blood in the vessel. This method of rapid and complete pressure in the case of aneurisms of the abdominal cavity has established the following points:—

1. That aneurisms of the abdominal aorta (or its branches) are curable by pressure.
2. That pressure is not necessarily a long process, as had been previously supposed, but when efficiently applied its action may be *rapid*—so rapid as to reduce its application from *many hours* to *as many minutes* in some cases.
3. That occlusion of the aorta may occur suddenly, without much risk to the patient, and that a very rapid opening up of new channels by the anastomoses of vessels is the means by which circulation is re-established in the lower parts of the body.
4. That the administration of chloroform is necessary in the application of this rapid method, inasmuch, as, without it, currents of blood are liable to pass through the sac of the aneurism, and disturb the coagulation going on there.
5. It is probable, from the rapidity with which the cure of a large aneurism may take place, that the process depends on coagulation of blood to a large extent, and not on the deposition of layers of fibrin only.

Before adopting any surgical measure for the cure of aneurism of the abdominal aorta, it is advisable to try the effect of absolute rest in the recumbent position for two or three weeks, and during this period of rest the treatment by iodide of potassium in large doses should also be adopted. The success attending Tuffnell's treatment by diet and rest alone would justify this preliminary process, and the still greater success following the use of large doses (30 grains three times daily) of iodide of potassium, gives this treatment a fair prospect of success.

Should the trial of rest, spare diet, and iodide of potassium have produced no change for the better, either in the disease or in the condition of the patient, we are justified in resorting to the use of pressure.

Two things are now to be considered:

1. The state of the patient as to general health, as to the state of the heart and arteries, and as to the state of the kidneys.

2. The site and anatomical relations of the aneurism.

First, as to the general condition of the patient, it is most essential to examine the important viscera, and the existence of organic disease of any of them is to be regarded as an obstacle to the success of the pressure treatment. Cachexia, either general or specific, also negatives the hope of success. Secondary and tertiary syphilis may yield to the iodide of potassium, which should be fully tried in such cases. The cachexia of cancer is of course decisive. Ordinary anæmia is unfavourable. Ascites renders pressure impossible, and œdema of any kind should be traced to its source. Should it indicate renal disease, with the slightest trace of albumen, blood, or casts in the urine, the pressure treatment is thereby contra-indicated. In all cases the urine should be carefully and repeatedly examined for albumen and sugar. Above all it is necessary to determine the state of the arterial system. Extensive degeneration, heart-disease, the existence of another aneurism in the chest or elsewhere, all contra-indicate a favourable result. Should there be an absence of these unfavourable conditions, the next step will be to inquire if the site of the aneurism permits of pressure being applied.

In considering the question of site in relation to the application of pressure, two methods may be pursued:—1. The ready method of trying the application of a tourniquet under chloroform, to ascertain if there is space enough above the aneurism to permit of the vessel being fully compressed by the instrument. 2. It will be found that pressure can rarely, if ever, be brought to bear on the vessel above the renal arteries.

If, however, in a very tall patient with a short chest and a wide epigastrium, pressure were contemplated, it would be unwise to venture on it without duly considering the site of the renal arteries in such a subject. In ordinary subjects there is no need to insist on the rule, 'that pressure should never be applied on or above the renals,' as this is simply impossible. So that we may safely say that we may press as high up as we can apply the pad of the tourniquet. In most cases this point will be found to coincide with the left triangle of the epigastrium. Although aneurisms above the renal arteries are never cured or treated by *proximal* pressure, they admit of treatment by *distal* pressure. Mr. Bryant's case shows that curative changes do occur in the aneurism, even as high as the cœliac axis, when subjected to distal pressure. Where other conditions are favourable we should continuously try distal pressure when other means fail to relieve the patient.

Below the origin of the renal arteries there is nothing to prevent the use of pressure. It is here both a practicable and tolerably safe procedure.

Let us now proceed to state what is to be done in a case where the trial of the rapid-pressure treatment for abdominal aneurism has been decided on. The patient needs to have the abdominal viscera unloaded, as far as possible, by a gentle aperient which removes flatus while acting. One aloe and assafœtida pill, followed by magnesia and rhubarb with ginger and other carminatives, will probably do this. If necessary an enema of assafœtida and turpentine may be given. The bladder is to be emptied. Nothing of a solid nature is to be eaten for three or four hours before the operation. The next step is to administer chloroform, and to put the patient fully under its influence before attempting pressure. Sometimes a preliminary administration of chloroform may be tried, to see how far and how easily the pressure may be applied without injury to the patient. As the patient may become exhausted by the long-continued anæsthesia, the administration of strong peptonised beef-tea enemata, during the operation, is necessary, and in some cases brandy in the enemata is needed.

The tourniquet may be that of Lister, or Carte, or the ordinary horse-shoe tourniquet may suffice. In the hands of an experienced surgeon the horse-shoe tourniquet is best, as he will, by skilfully guiding it, be able to keep it on the vessel during any accidental movement of the patient. The most important point in applying pressure is to secure that amount of it which will stop the flow into the aneurism, without injuring adjacent or intervening parts. Experience, tactile skill, manual dexterity, and sound judgment will best aid the operator here, and it will be seen that no mere tyro or student can be trusted in such a delicate operation. The surgeon must make up his mind to give up a day to the work and to take the immediate supervision of every detail, if he is to succeed. Apart from the consideration of internal injury which may be inflicted by the pressure, there is the all-important point of fully and completely arresting all flow of blood through the aneurism, which is essential to a rapid result.

If a rapid cure is aimed at, the shorter the period of pressure in this region the better. The operator must bear in mind that, every time he allows a current of blood to slip past the tourniquet, the chance of a rapid cure is reduced. If these rushes of blood are allowed to take place, the cure cannot be rapid, for each current breaks in on the coagulating process and carries the stationary blood onward, so that the process has to be recommenced. Granted that each time a volume of blood is held stationary a layer of fibrin may be deposited, that does not lead to a rapid result. It may lead to a cure by alternated layers of fibrin and blood, but this means the prolonged and probably the repeated application of the tourniquet. To succeed in a first attempt of two, three, four or more hours, we must have full command of the aorta, and aim at holding the blood in the aneurism undisturbed. In all cases slight currents will pass through the sac, and thus, instead of one mass of coagulated blood filling the vessel, we are sure to have successive deposits of coagula.

The writer has again and again succeeded in stopping the pulsations in an aneurism by holding the vessel with a firm and careful hand for half an hour, after unsuccessful pressure had been tried for a good many hours. When the pressure does not succeed in reducing the size or pulsation of an aneurism in four or five hours, we must carefully look to the state of the patient, and the slightest indication of failure of the pulse or shock must warn us to remove the pressure and chloroform, and ascertain how the patient has borne the treatment. Unless there is an entire absence of any evidence of shock or injury to the ganglionic nerve-centres, of failure of the heart's action, or injury to the stomach or duodenum from pressure, we must postpone our efforts. By trying the pressure too long or too severely our object will be defeated. When the pressure is removed, it is not infrequently noticed that, although the aneurism still pulsates, its pulsations are much reduced in force and extent. In these cases it is well to watch the patient, and to keep him at rest, free from the slightest excitement, as it is probable the pulsations will gradually disappear, and the aneurism may thus be cured.

Where proximal pressure fails, or is inadmissible, the application of distal pressure is advisable, and some authorities urge the application of distal as well as proximal pressure in all cases. After the consolidation of an aneurism, it is necessary to apply warmth to the extremities and flannel to the abdomen, and to feed the patient cautiously.

New vessels will appear in the abdominal wall in a few days, and after a lengthened period pulsation may be felt in the iliac and femoral arteries. William Murray.

ABDOMINAL HERNIA.—This term is applied to protrusions through the antero-lateral parts of the abdominal parietes below the umbilicus, exclusive of those through the inguinal canal. The hernia is usually in the middle line, and most commonly follows operation wounds, as that for ovariotomy. The rupture may appear within a few weeks of the healing of the ovariotomy wound; but, as a rule, it does not present itself until many months have elapsed. It may not be noticed until after an interval of years. It may follow upon accidental wounds, upon abscess, contusions, rupture of the abdominal muscles, destructive burns, and may be apparently the consequence of pregnancy, ascites, &c.

It is usually met with in female adults. The tumours formed are, as a rule, large. The sac often has no neck. In some ruptures of old standing the tumour may become pendulous. These herniæ are seldom the seat of acute change. The more pendulous may become incarcerated when they contain colon, some of the smaller and more circumscribed protrusions may be the seat of inflammation, but the strangulation of a ventral hernia is an occurrence of great rarity.

The rupture should be supported by a suitable abdominal belt.

Frederick Treves.

ABDOMINAL SECTION. *See* Laparotomy; Cæsarean Section; Ovariotomy; Oöphorectomy; Uterus, Extirpation of.

ABDOMINAL SURGERY.—No department of surgery has made more rapid progress during the last quarter of a century than that of the abdomen. The fear of peritonitis which prevailed so strongly in the early part of the century deterred surgeons from opening the cavity of the abdomen, except under the most desperate circumstances, and the delay thus encouraged was of itself in great measure the cause of the fatal result so frequently witnessed. The first ovariotomists had to encounter not merely the ordinary difficulties inherent to all novel procedures, but had to withstand the violent prejudices of those whose knowledge was limited to the bad teaching of former years, and whose experience was *nil*.

Probably the experimental teaching of Spencer Wells, that the edges of the cut peritoneum, when brought together, would unite in a few hours, was the greatest step towards the success of modern abdominal surgery; and next must be put the practice of perfect cleanliness, so little thought of in former years, both as regards the body of the patient and his surroundings, and the hands and instruments of the surgeon. Whether the strictly antiseptic practice of Lister has done much for abdominal surgery must still be considered *sub judice*. Ovariotomy had become a success before the days of carbolic spray, and it is yet an open question whether more is not lost than gained by exposing the interior of the peritoneum and the contents of the abdomen to a carbolic or other antiseptic spray for one or two hours at a time.

The treatment of certain INJURIES OF THE ABDOMEN, notably of rupture of the bladder, has been greatly influenced by modern views, and the question of opening the abdomen with the view of stitching up the bladder may now be fairly entertained. In the treatment of INTESTINAL OBSTRUCTION, the operation of laparotomy for the division of a band or the unfolding of an intussusception has yielded excellent results, and has emboldened surgeons to remove gall-stones, and even to excise portions of the intestinal canal (ENTERECTOMY). GASTROSTOMY, for the relief of stricture of the œsophagus, has become a success, at least in cases of traumatic stricture; and forcible dilatation of the pylorus has yielded better results than excision of that sphincter.

Early COLOTOMY has been proved greatly to prolong life, in comparative comfort, when the large intestine is the seat of cancer, and in a few instances an attempt has been made to excise the diseased structure (COLECTOMY). Removal of the lower end of the rectum is an operation which must be said to be still on its trial, since the cases suitable for its performance are few and far between, whilst the risks of the proceeding are great, and its after-results are not, so far, very encouraging.

The whole surgery of the Female Pelvic Organs has undergone a change. OVARIOTOMY is no longer confined to enormous tumours, the bulk of which is estimated by the gallons of fluid contained, but ovarian tumours are diagnosed and removed when small, and diseased and painful ovaries with no special enlargement are extracted (OÖPHORECTOMY), whilst the FALLOPIAN TUBES are also dealt with if necessary. UTERINE TUMOURS are removed when necessary by abdominal incision, with little more risk than those of the ovary, and EXCISION OF THE UTERUS for malignant disease is now a recognised surgical proceeding.

The surgery of the Kidney has grown up with a rapidity almost marvellous. Incision for the relief of renal abscess (NEPHROTOMY) has been followed by the successful removal of calculi from the kidney or its pelvis (NEPHRO-LITHOTOMY); and even removal of the entire kidney, for malignant disease (NEPHRECTOMY), has been crowned with success.

The surgery of the Urinary Organs has received a notable extension by the successful removal of TUMOURS OF THE BLADDER in many cases till lately deemed irremediable; and the revival of the supra-pubic method of LITHOTOMY, rendered at once easy and safe by the distension of the rectum, offers a prospect of increased success in the treatment of large calculi.

CHRISTOPHER HEATH.

ABDOMINAL TUMOURS, Diagnosis of.—The pathological conditions which produce recognisable swellings or tumours of the abdominal walls, or of the organs contained in the cavity, are very numerous, and though each will be found in its proper place in the special articles, some general notice of these diseases is necessary. It is obviously impossible to deal with the causes, pathology, diagnosis, symptoms and treatment of each, but the following is the method which should be employed in their general diagnosis.

The patient should be laid on the back with the head and shoulders well supported by an inclined plane of pillows, and the knees should be raised, and if necessary also supported by a firm pillow placed under them, so that the abdominal muscles are relaxed. The whole surface of the abdomen should be thoroughly exposed to view, and the relaxation will be aided by keeping the patient in conversation, or causing a succession of deep respirations to be made, while the mouth is held open. Careful inspection, palpation, percussion, and auscultation should then be employed. If the parts which appear to be healthy are first systematically examined by the above methods, a diagnosis by exclusion is made, which can then be confirmed, or corrected, by varying the position of the patient, and repeating the examination. It is always better to pass from healthy to diseased structures, than to examine the tumour first.

The systematic examination will be easier if the tumours are considered in three groups: 1. Tumours of the abdominal parietes; 2. Tumours of the peritoneum, and of the organs contained in its cavity; 3. Tumours of the tissues and organs which lie behind the peritoneum.

1. *Tumours of the Abdominal Parietes.* The only growths in the parietes which will be found difficult to differentiate from tumours contained in the peritoneum, are those which are prone to cause inflammation of the peritoneal surfaces, and thus to contract adhesions to the organs contained in the cavity, especially to the omentum and intestines. These are inflammation (cellulitis), abscess, hydatid cysts, carcinoma and sarcoma.

Inflammation.—Considerable swellings of a diffused nature may arise, from some part of the areolar or fibrous tissues of the abdominal wall.

Abscess.—A later stage of inflammation, but one not necessarily reached, if rest and appropriate soothing treatment be used in time. It is most common in the sheaths of the muscles, as the result of strain or other injury.

Cysts.—The most common are hydatids and sebaceous cysts.

Fatty Tumours are not at all rare.

Fibrous Tumours.—These are of frequent occurrence, and usually arise from the sheaths of the muscles.

Carcinoma is rare, but is occasionally met with, especially in the neighbourhood of the umbilicus.

Sarcoma, in some of its many forms, though not so common as the simple fibrous tumour, is much more often met with than carcinoma.

Obesity, Œdema, and Elephantiasis must also be noted as affections of the parietes not infrequently mistaken for intra-peritoneal tumours.

Hernia.—The ventral and umbilical forms of hernia may contain either serum, omentum, or intestine. The ovary and a portion of a fibro-myoma of the uterus have also been found in ventral herniæ. This disease is placed in this group because, though really intra-peritoneal, it is from its earliest formation a projection into or through the tissues forming the parietes.

Contraction of Abdominal Muscles.—A single muscle or a group may suffer from spasmodic contraction, and simulate a solid growth (phantom tumour).

2. *Intra-peritoneal Tumours* may arise from—

Peritoneum.—Any part of the peritoneal membrane may be itself the seat of a solid or cystic growth. The former are usually malignant, and though occasionally primary are more often secondary.

Liver.—The diseases of the liver which give rise to abdominal tumour are degenerations causing enlargement of the whole organ, such as the early stage of cirrhosis, amyloid degeneration, and carcinoma; simple serous cysts, abscess, hydatids, and carcinoma affecting one lobe rather than the whole organ.

Gall-bladder.—Gall-stones are the most common cause of enlargement of this organ, but it is also liable to distension from catarrhal occlusion of the duct, and it is occasionally the seat of malignant tumour. One very remarkable case of solid tumour has come under the notice of the writer. Its seat was verified by exploratory incision, and it entirely disappeared, apparently from changes induced by free puncture with the aspirating needle.

Pancreas.—This organ is occasionally the seat of malignant disease, and may form an abdominal tumour of very considerable size.

Spleen.—Abscess of the spleen, simple cystic disease, hydatids, simple hypertrophy, and enlargement as a part of the general disease leukæmia, are all met with as abdominal tumours, and with the exception of the last are of great importance to the practical surgeon.

Stomach.—Cancer is the disease which most often affects this organ, so as to cause a definite tumour. Unusual distension with food or gas may also have to be considered, and in females large collections of hair, cotton, &c., may be occasionally met with, and are exceedingly difficult to differentiate from fæcal impaction in the large intestine.

Intestine.—Fæcal impactions, volvulus, intussusception, carcinoma, and sarcoma all form abdominal tumours of a kind requiring great care for correct diagnosis.

Omentum.—Cancer, hydatids, and simple cysts are, in the order in which they are given, the tumours most common in the omentum.

The *Mesentery* is liable to the same diseases as the omentum, and has been known to be the seat of very large sarcomata and cystosarcomata. It occupies a position between the intra-peritoneal and retro-peritoneal groups, and its cystic growths are very difficult to diagnose from renal tumours.

Bladder.—Distension.

Uterus.—Pregnancy, hydramnios, hydatidiform degeneration of the chorion, moles, fibro-cystic tumour, fibro-myoma, sarcoma, carcinoma, metritis, hæmatometra, physometra, and abscess of the uterine wall, all cause enlargements of this organ, which have to be considered in examining an abdominal tumour.

Round Ligaments.—Fibrous tumours of these ligaments sometimes attain a very considerable size, but they are usually more in the groin than in the abdomen.

Broad Ligament.—Simple cysts, parovarian cysts, papilloma-bearing cysts, hydatids, cellulitis, abscess, fibroma and sarcoma, all have their seat in this ligament, and are often extremely difficult to diagnose from like affections of the ovary.

Fallopian Tubes.—Hydro-salpinx (accumulation of serum in the tube), pyosalpinx (accumulation of pus in the tube), hæmato-salpinx (accumulation of blood in the tube), papillomatous disease of the lining membrane, and tubal pregnancy, are all conditions which may present themselves as abdominal tumours, though they are more often confined to the pelvis.

Ovaries.—Unilocular and multilocular cysts, dermoid cysts, fibroma, sarcoma, carcinoma, abscess and ovarian pregnancy, are all of great importance, and the cysts especially so from their very common occurrence.

Subperitoneal Cyst.—This may arise in any portion of the subendothelial connective tissue. It is placed in this class for the same reason that hernia is placed in the previous class.

Encysted Peritoneal Effusion or *Dropsy* is occasionally met with, along with malignant disease of omentum, &c., or independently, as a result of some localised inflammatory process.

Peritoneal Hæmatocele arises when a vessel ruptures into the peritoneal cavity, or when a retro-peritoneal hæmatocele does so, and the blood only becomes encysted by the agglutination of intestines, or other organs, whose peritoneal coats have become irritated by the presence of the blood.

Besides this long array of diseases of organs contained in the peritoneum, we have also to mention the following more general affections.

Tympanites.—The gas usually accumulates in the intestines, but occasionally in the peritoneal cavity. The percussion sound is hyper-resonant all over the abdomen.

Ascites or *Hydroperitoneum* may arise from diseases affecting organs outside the cavity, such as the heart and kidneys, or it may arise from tubercle, or from papillary disease or peritoneal cancer of the peritoneum, or from the irritation set up by almost any of the many tumours named above.

Phantom.—This is a curious disease chiefly met with in women who believe themselves to be pregnant when they are not so, but also occasionally associated with some derangement of the female sexual organs. It may affect the whole abdomen or a portion only, and appears to be due to an arched and rigid condition of the abdominal muscles. It is sometimes extremely difficult to distinguish from a real tumour, but it may be suspected when an enormously distended abdomen is resonant all over, or when a localised swelling is so; and the diagnosis may be made certain by the use of an anæsthetic, for with complete anæsthesia the tumour will disappear, to rise again as the patient returns to consciousness. It may simulate a tumour of almost any abdominal organ.

Extra-uterine Pregnancy.—Two varieties of this disease have already been named as occurring in the Fallopian tubes and ovaries, and it only remains to mention the abdominal form, in which the ovum gets altogether away from the uterus, tubes, and ovaries, and becomes implanted on some other peritoneal surface.

3. *Retro-peritoneal Tumours.*—*Aneurisms* of the abdominal aorta or of its main branches.

Abscesses of various kinds. These more often appear at some point outside the abdomen. Iliac and pelvic abscesses, however, often encroach on the abdominal cavity.

Cysts may have their origin in the retro-peritoneal cellular tissue.

Solid Tumours.—Either fibroma, sarcoma, or carcinoma may also arise in the retro-peritoneal cellular tissue, but the two latter usually affect the lumbar glands and are secondary in their origin.

Kidneys. — The distensions and neoplasms of the kidneys or ureters are the most important of the retro-peritoneal tumours and are hydronephrosis, pyonephrosis, calculous pyelitis, hydatids, sarcoma, and carcinoma.

Hæmatocele.—Retro-peritoneal hæmatocele is usually pelvic in its origin, but may become abdominal and form a tumour of great size.

The above recapitulation of the tumours which may be met with in the abdomen, will serve to refresh the memory of those who are not frequently called upon to diagnose tumours in this situation, but it will be necessary to refer to the special articles for detailed information.

J. Knowsley Thornton.

ABSCESS.—*Definition.*—An abscess is a localised collection of matter in any organ or tissue, and the term is often extended to include suppuration in certain of the already existing cavities of the body. It may result from any inflammatory process which reaches a sufficient degree of intensity. Thus there may be an abscess of the subcutaneous tissue, or in the substance of a bone, in the brain or the liver, in a bursa, a joint, or the sheath of a tendon; and we also speak of a peritoneal or a pleural abscess, if the suppuration in these situations be circumscribed.

Given the inflammatory process, complex and highly differentiated tissues become crowded with small round cells (whether by a proliferation of previously existing cells, or by the escape of white blood-corpuscles from the blood, or both, it would be out of place here to discuss), and the special structure of the part disappears, to be replaced by a tissue made up of these small round cells loosely held together and permeated by vessels—in other words, by granulation-tissue. A slight increase of the inflammatory process causes this lowly-organised tissue to generate a still less highly organised material—namely, pus—and an abscess is the result. The process is somewhat different in the case of an abscess developed in a previously existing cavity—for example, in the knee-joint; here we must assume that the lining wall of the space is converted by the inflammatory action into a condition, pathologically if not to the naked eye, resembling granulation-tissue, from which, in its turn, the pus of the abscess is developed. It is thus possible that the effusion may be purulent from the first, as is most likely the case in the suppuration of joints during the course of pyæmia; or it may be serous at first, and become purulent at a later stage, when the inflammation of the enclosing surface is further advanced, as is illustrated in the case of acute synovitis of a joint going on to suppuration, or in the abscess which results from inflammation of the bursa patellæ.

Causes.—The causation of abscess is at the present time one of great uncertainty, and one that is exciting considerable controversy. Thus, while it is not improbable that we may some day be able to classify all the causes under the heads mechanical and chemical, it is obvious that there are at present many which do not belong apparently to either category. Under the head *mechanical* are such abscesses as arise from pressure—for example, subcutaneous decubitus—or from the presence of clean, though mechanically irritating, foreign bodies, as when suppuration occurs round a silk ligature long after the wound has healed, or round a piece of a needle which may have entered some time previously. To this class, also, belong the numerous abscesses caused by simple tension, as when a wound is imperfectly drained and becomes distended by the effused serum; or when the duct of a secreting gland is obstructed and the gland is distended by its own secretion. Under the head *chemical* we may, though with some reservation, include that most important class of abscesses which depend upon septic agencies, embracing, at all events, the abscesses of phlegmonous erysipelas and its allied diseases, those of septicæmia and pyæmia; though it must be remarked that micro-organisms are always present in these cases, and that we are totally unable to say how far and in what way they may be irritating in themselves, independently of the acrid fluids which accompany their growth. This class also includes such cases as the suppuration which accompanies the subcutaneous injection of an aseptic or an antiseptic material, say corrosive sublimate, and perhaps the suppuration of lymphatic glands drawing their supply of lymph from inflamed regions.

We have not, however, at present sufficient knowledge to determine the cause of many abscesses, such, for example, as the chronic suppuration of glands, bones, and other parts in strumous subjects, the suppuration of joints in rheumatic people, or the apparently spontaneous development of an abscess in the interior of a deep viscus, such as the brain; nor can we say whether or not an abscess may originate by what is commonly called sympathy, or by irritation transmitted through the nervous system, though this is a convenient method of expressing, without explaining, certain obscure conditions.

Whatever may have been the original cause of an abscess, its enlargement is determined partly by the persistence of this cause if unremoved, partly by the existence of tension, which, as was stated above, is a potent cause of inflammation. It thus happens that, almost without exception, the collection of matter continues to increase, and the abscess spreads in the direction of least resistance, the opposing substances being either displaced, as is common in the more chronic form of abscesses, or actually involved in the inflammatory changes. We say, almost without exception, because cases occur now and then, in which the contents of an abscess, which have been proved to be actual pus by the withdrawal of an infinitesimal quantity, have subsequently been, without further interference, absorbed, and have completely disappeared. The matter then makes its way ultimately, though often by a long and circuitous route, to a free surface, either that of the skin or that of some internal cavity or hollow organ. When it has reached the surface, *pointing* is said to occur, and when rupture takes place the contents are evacuated. By this means tension is more or less relieved; but, in the majority of cases, a new element of irritation, viz. putrefaction, is introduced. Nature's opening is usually too small, but supposing that the tension is completely relieved, and the original source of irritation is no longer present, and the putrefactive element be not productive of serious mischief, the sides of the cavity fall together, and the granulations lining its wall, to which the name of *pyogenic membrane* is applied, being no longer irritated, cease to develop, or do so to a less extent than before. The discharge, which is then either serous or purulent, escapes from the opening, and the constant growth of the granulations gradually fills up the abscess-cavity, healing taking place, as is said, from below.

But if the original source of mischief be still present, as, e.g., in the case of an abscess caused by diseased bone or foreign body, the cavity contracts, but continues to discharge, and a narrow suppurating track or *sinus* remains, communicating at the one end with the source of irritation, and at the other with the point of rupture. If the putrefactive element be productive of mischief, and especially—as is often the case when an abscess has burst spontaneously—if the opening be insufficient, *burrowing* takes place; that, is matter finds its way amongst the cellular planes, or through the least resisting structures, and thus other secondary tracks may be developed from the original abscess. In many cases a second or a third, or even multiple openings, may occur; and if one of such openings be into an internal hollow viscus or cavity, whilst another is on the surface of the body, what is known as a *fistula* is the result. A fistula may also follow a simultaneous wound of such an internal surface and the skin, or may originate on such a surface and make its second opening by bursting externally. The best example of this condition is the *fistula in ano*, which, commencing in many cases as a submucous abscess, bursts both into the skin of the buttock and also into the rectum, leaving a fistulous track communicating both with the bowel and with the surface of the body. These fistulæ have usually no tendency to heal spontaneously. The term fistula is also applied to sinuses communicating between two internal hollow organs, as between the rectum or bladder and the vagina; or to similar tracks that have resulted from wound or rupture of an internal organ such as the gall-bladder, the lacrymal duct, or the intestine. Lastly, a fistula may result from a congenital defect, as when a urinary or fæcal fistula exists at the umbilicus, or an œsophageal fistula in the neck, depending on a nonclosure of one of the branchial arches.

Acute Abscess.—A good illustration is the acute abscess of the breast which occurs during the active condition of the gland. Here the source of irritation is, probably, a mechanical one, viz. the plugging of one of the ducts, with retention of the secretion in one of the acini, and consequent tension; though the frequency of the association of this abscess with eczema of the nipple suggests the possibility of another explanation. The resulting inflammation involves the surrounding parts to a greater or lesser degree, and at last, in the centre of the inflamed area, suppuration takes place, no doubt accompanied by the death of a larger or smaller portion of tissue. The occurrence of suppuration increases the amount of tension, and, as it continues, the cavity rapidly increases in size, principally by the formation of more pus, but partly by the breaking down of the inflamed tissue. This process advances until the matter reaches the surface, or until the abscess is opened by the surgeon; but the necrosis bears so small a proportion to the suppuration that, on evacuating the contents, the sloughs are not perceptible, and only pus is seen to escape.

Chronic Abscess, on the other hand, is very slow of development, and unless, in the course of its enlargement, it involves some sensitive structures, is unaccompanied by the signs of acute inflammation. It gradually makes its way to the surface without causing heat or pain or redness, for the most part displacing the structures that it meets with, and following the cellular planes and the course of vessels; and at last, like an acute abscess, it involves the skin, which turns of a purplish red colour over a comparatively small area. A piece of this reddened skin then sloughs, and the contents of the abscess escape. Good examples of this form are to be found in the ordinary *cold* or *lymphatic* abscess of the soft parts, or in a psoas abscess starting from caries of the vertebræ. A cold abscess begins, we know not why (though it may be plausibly held to be a tubercular inflammation), in an almost imperceptible manner. The patient is probably unaware of its existence until the presence of a distinct swelling attracts his attention, and its growth is not accompanied by any other inconvenience. Abscesses of this kind sometimes occur in considerable numbers in persons predisposed to their development by ill-health or the strumous diathesis.

Abscesses, in their course, are usually guided by the strong fasciæ of the body; they may cause absorption of the soft or firmer structures, and occasionally open into vessels; but, as a rule, vessels and nerves are simply denuded by them, and remain as bands stretching across the track of suppuration. If ulceration of an artery or vein occur, the cavity becomes distended with blood, and, in the case of an artery, a pulsating tumour is formed, which may easily be, and has often been, mistaken for an aneurism.

The *contents* of an acute abscess are usually thick, yellow pus, mixed sometimes with small clots of altered blood and shreddy particles of slough; those of a chronic abscess are sometimes thick, but often thin, and indeed occasionally quite serous, and mixed at times with larger or smaller flakes of coagulated lymph. If the contents are actually serous, the abscess will have been accompanied by an exceptionally mild and chronic inflammation, and to this form the term *serous abscess* has been applied. It must be understood that this statement is in very general terms, and that the contents of both acute and chronic abscesses are liable to every form of variation; thus in an abscess of the breast the pus may be mixed with milk; in a cæcal abscess it may contain fæces; in a hepatic abscess, bile or broken-down liver tissue; in a psoas abscess, particles of bone; in a pulmonary abscess, mucus; in a renal abscess, urine, and so on: but it is impossible in this article to enter on this part of the subject with anything approaching to detail. The pus of an unopened abscess is not always sweet, and not always free from micro-organisms; a perineal or an ischio-rectal abscess has often a marked fæcal odour, even though there be no communication with the bowel, and abscesses in the axilla and in some other situations often contain pus with a remarkably offensive smell. Almost all acute abscesses again, whether sweet or not, have been shown to contain micrococci, and this observation applies even to abscesses which have been caused by the injection of irritating, but aseptic, materials; but it does not follow that these will not follow an aseptic course if treated properly. In other words, it does not follow that the organisms contained in the unopened abscess are those which accompany or produce putrefaction.

Treatment.—The treatment of abscess will vary in accordance with the different conditions which have been described, the only essentials that can be laid down for all cases being that the surgeon should secure—1st, a free opening, in a dependent position if possible; 2ndly, efficient drainage; and, 3rdly, antiseptic management of the case, if he can.

The treatment of acute abscesses may be divided into that suitable for the pre-suppurating stage, and that which is required when the abscess is ripe. In the former, our efforts should be directed to the alleviation of pain, and, if possible, to the prevention of suppuration, which is best attained by the application of heat, either by means of hot fomentations, or some form of poultice. This may be supplemented by frequent bathing of the part in hot water, or by the inunction of the region with a preparation of belladonna (Ext. belladonnæ ʒij., Glycerini f℥j.).

The part, when practicable, should be elevated, and all undue pressure should be avoided. Occasionally, local blood-letting may be practised with advantage. In the second stage, when suppuration has occurred, it is in most cases best to make a free incision, which affords the most satisfactory exit for the pus, and reduces the inflammation by relieving the tension. But in cases where the matter is deep, and where a long scar is objectionable from its unsightliness, as, e.g., in acute abscesses of the breast or neck, an excellent result may be obtained by making an opening in a suitable position just large enough to admit a drainage-tube of good size; provided, as should always be the case if practicable, the opening be made with efficient antiseptic precautions. In the after-treatment, if the pus be putrid, a hot and moist application should be used. Boracic fomentations, viz. boracic lint wrung out of hot water, and covered with guttapercha tissue; or an antiseptic poultice, made by mixing boracic acid or iodoform with linseed meal, will be found excellent applications. Iodoform may be applied when practicable to the interior of a putrid abscess, or it may be mopped out with some antiseptic lotion —chloride of zinc, gr. 40 ad f℥j., carbolic acid 1–20, or whatever is found convenient.

Similar, though milder, lotions may be employed on subsequent occasions if it be found necessary. In many examples of putrid abscess, whether acute or chronic, if it be thought practicable to render the cavity pure, this end may be most easily attained by removing the granulations lining it by means of Volkmann's sharp spoon, or other suitable scraping instruments, before applying the potent germicides mentioned above; these sharp spoons are made long and short, so that they may serve for superficial or deep abscesses, and they are strong enough for the treatment of sinuses in the interior of a bone.

The treatment of a chronic abscess is essentially the same as that of an acute abscess, but may in some respects be modified; thus it is not necessary to anticipate the period of incision by use of fomentation or poulticing; it is not a matter of importance that the incision should be a long one, provided that it be sufficient to admit a tube of sufficient calibre. On the other hand, it is perhaps of more importance that the opening should be made in a position which will favour drainage, and thus prevent the retention of matter in a diverticulum or pocket, and it is often a matter of great importance to scrape away the thick and very lowly organised pyogenic membrane, which is, in many cases, but little prone to take on a healthy reparative action. The reader is referred to the article on ANTISEPTIC SURGERY for the methods of managing both an acute and a chronic abscess. It may be pointed out, however, that it is not essential that elaborate machinery or complicated dressings should be employed in order to conduct the antiseptic treatment of an abscess rigidly from beginning to end; though, if they are at hand, it is no doubt better—especially in cases such as that of psoas abscess, where the life of the patient probably depends upon the maintenance of the aseptic state—that every possible known precaution should be employed.

The following plan is one which the writer can recommend for simple cases. Before making the incision, the skin, the instruments, and the operator's hands, are to be thoroughly purified with carbolic acid solution (1–20). A dressing has been previously prepared consisting of a piece of lint soaked through and through with an ointment consisting of Iodoform gr. lx., Ol. eucalypti f℥j., Paraffine f℥ijss., Vaseline ℥ijss. After making the incision, pressure is maintained over the abscess by the left hand of the surgeon, in order to prevent the regurgitation of air into it; and, if a drainage-tube be required, it is inserted, and the dressing is applied before this pressure is relaxed. Outside the piece of lint is placed a large pad of salicylic wool, iodoform wool, or carbolised tow, and the whole is secured with a bandage. The whole proceeding should be accomplished as expeditiously as possible, and when the dressing is changed, similar precautions should be employed, viz. a piece of rag is soaked in the carbolic acid solution, and as soon as the dressing is removed, it is placed over the incision. If the tube is to be removed, a few drops of the lotion should be allowed to fall on the wound whilst it is being taken out or returned. The piece of rag (guard) is applied while any necessary cleaning in the neighbourhood of the wound is taking place, and is then replaced by the deep dressing. After this the outlying parts are purified by the lotion, and lastly the absorbent outer dressing is reapplied as before. This simple process has been described in detail because there is a prevalent belief that there is no halfway-house between rigid Listerism and the most primitive form of poulticing; whereas, as was mentioned above, even a poultice may be rendered, in the strictest sense of the term, antiseptic. Many other and equally good plans will, no doubt, suggest themselves to the practical surgeon, in which, by the employment of iodine, benzoin, carbolized oil, or other materials, and by the exercise of a little common sense, he may keep even the largest abscesses free from putrefaction.

If the matter show a disposition to 'pocket' in an outlying part of the abscess, or if burrowing occur, it may be necessary to make a *counter-opening*, by which is meant a second opening in a position suitable for drainage, and at a distance from the first incision. This may often be accomplished by passing a probe from the original incision to the required point, and cutting upon its extremity, which is made to project under the skin. If the pocket is a deep one, it may be advisable to force the probe, or better a stout metal bougie, through the superjacent soft parts, and, after cutting on its point, to follow back the track it has made either with the finger or a pair of dressing-forceps, by expanding the blades of which the second opening may be dilated. A tube is then inserted into the counter-opening. It is often convenient to pass a tube through from one opening to the other, and, after the track has contracted to a mere sinus, to cut the tube in the middle, and afterwards gradually shorten the two remaining portions. Several counter-openings may sometimes be required.

The *treatment of a sinus* depends upon its cause. If there be a source of permanent irritation at the bottom, it is obvious that the sinus cannot heal till this has been removed. If it depend upon insufficient drainage, this must be secured by enlarging the opening and inserting a drainage-tube, or by making a counter-opening. If it be merely the result of a sluggish action of the parts, this may be rectified by scraping the sinus with a sharp spoon; or by applying some irritating or stimulating material, such as a piece of lint impregnated with red oxide of mercury ointment, or by the injection with a solution of sulphate of zinc 2 grains to the ounce, or sulphate of copper 2 grains to the ounce, or some similar substance; or the application of the solid nitrate of silver, by coating a probe with this caustic. The healing of a sinus may often be promoted by the application of a blister over the orifice, and sometimes by the judicious use of pressure over the deeper parts.

Rickman John Godlee.

ABSCESS-KNIFE.—For the purpose of incising abscesses near the surface of the body, various forms of cutting instrument have been used. In a case of a purulent collection of slight extent, as a boil or a minute abscess, an ordinary bleeding lancet will be found a suitable instrument; whilst in large abscesses many surgeons make use either of a straight or curved bistoury, or of a stout scalpel with a broad and double-edged blade. The term abscess-knife, however, is restricted to two forms of instrument, of which one, known as Syme's knife, has a thin, slightly curved, and double-edged blade, whilst the other, known as Paget's knife, consists of a narrow, straight blade, attached to its handle by a thin metal stalk.

ABSCESS OF BONE, Chronic.—This is a disease of great practical and clinical importance, for complete relief can, as a rule, only be obtained by operation. It almost always occurs in the cancellous tissue at either end of a long bone, especially in the head or lower end of the tibia.

Causes.—Very little can be said definitely as to its causation. There is very frequently a history of an injury or accident, occurring some little time before the first symptom of the disease. The patients are oftentimes strumous subjects, and there is a suspicion in many that the disease is tubercular, although this has not yet been proved to be so in any considerable number of cases.

Pathology.—Chronic abscess of bone commences by rarefying ostitis of a localised portion of the cancellous tissue, the central part of which becomes fluid pus, with possibly a very small sequestrum. The changes by which this is effected will be found described under Ostitis, Necrosis, and Osteomyelitis. The peripheral portion of the inflamed area frequently becomes very dense and hard, as in condensing ostitis, and tends to prevent the pus from coming to the surface. It may, however, gradually, in the course of years, work its way through the bone or from the first be more superficial, making itself evident as a fluctuating tumour beneath the skin. The part affected is almost always one of the ends of a long bone, the disease occurring with much greater frequency at either end of the tibia than in any other bone. It is also found in the lower end of the femur, and in the articular extremities of the humerus, ulna, or radius. Specimens are preserved in our museums of chronic abscesses in other bones, and a few instances are recorded in which the diaphysis of a long bone has been so affected. When it occurs, as it does most frequently, in the articular extremity of a long bone, there is a danger of its opening into the joint.

Symptoms.—More or less dull aching pain, which is much worse at night and in wet weather, is the prominent symptom of which the patient complains. On examination, a swelling will commonly be found at one or other extremity of a long bone. This swelling will be seen and felt to be due to an enlargement of the bone, unless the pus has already made its way through the cortical layer and formed a small area of fluctuation on the surface. Still, even in that case, the peripheral part of the swelling will be found to be produced by the enlargement of the bone beneath. Generally, however, the swelling is uniform, dense, hard, and resistant to the touch, and on firm pressure at one spot the patient will be found, almost without exception, to complain of extreme pain. This spot is generally not larger than a sixpence or a shilling, and is in about the centre of the swelling and on its most superficial aspect, as, for example, on the inner surface in the case of the tibia.

This tenderness on pressure is probably the most characteristic symptom of such a chronic abscess, especially when taken in conjunction with the increased size of the bone and the persistent pain at night. There may also be slight œdema of the soft parts over this tender area, so as to leave a mark of 'pitting on pressure.' The pain at night has generally existed a long time—for months as a rule—before an examination has led to the discovery of enlargement of bone and tenderness on pressure, and occasionally one or more years have elapsed before the diagnosis has been made.

Treatment.—If the pus has found its way to the surface so as to be superficial, an incision must be made, and the opening in the bone searched for. The osseous sinus is then enlarged, and the cavity in the articular extremity of the bone examined for a sequestrum. Fluctuation is not, however, often detected, and the trephine has to be applied to the most tender spot, and a circle of bone removed. The abscess will in this way generally be opened and a free vent given to the pus. Should this not be the case, the cavity may have been missed by the opening being made a little on one side. Esmarch's bandage will be found of great assistance in this operation, and should always be used, as the amount of pus may be very small and quite obscured by the blood, which otherwise freely flows from the highly vascular bone to which the trephine is applied.

If, notwithstanding this precaution, no pus has been seen during the operation, the sides of the aperture made by the trephine should be perforated by a drill, in the hope that the supposed cavity may in this way be discovered. Pus having been found, a free opening must be made into the cavity in which it is contained. If, however, these measures fail to discover any pus, the surgeon need not be disappointed, as the operation will almost certainly give relief by the removal of tension and abstraction of blood from the engorged bone.

As regards the method of dressing, antiseptics should, if possible, be employed. The cavity should be sponged out with chloride of zinc (40 grs. to f℥j.), and some absorbent dry dressing applied. Wood wool and corrosive sublimate gauze, or iodoform gauze with salicylic wool, are probably the best. If the above method has been properly carried out, there need be no fear of decomposition, and the dressing may not require changing for a week, or even longer. The cavity in the bone becomes in this way much more quickly filled up with rapidly organizing tissue than under the older method of dressing.

When the cavity in the bone has thus become filled with inflammatory new formation, fresh bone is rapidly reproduced, and the patient restored to perfect health.

H. H. Clutton.

ABSORBENT SYSTEM. *See* Lymphadenitis; Lymphadenoma; Lymphangitis.

ACARUS. Acarus Folliculorum.—A minute, wormlike grub which is found in healthy or diseased sebaceous follicles. In man it is harmless, but a variety exists in certain of the lower animals which causes boils. It varies in length from $\frac{1}{12}$th to $\frac{1}{6}$th of a line, and is eight or ten times as long as it is broad. It has a head, thorax, long abdomen, and four small legs on each side of the thorax. For microscopic purposes, it can be obtained by mixing sebaceous matter, collected from some of the larger follicles of the face or back, with an equal quantity of oil.

The parasite is not the cause of comedones, acne, or seborrhœa.

Acarus Scabiei.—This is the name given to the mite which is the essential cause of the disease known as the *Itch* or *Scabies*. *See* Scabies.

It belongs to the class Arachnoidea. There are both female and male acari, but the former is the one most easily found, as it can be dug out from the little cuniculus or tunnel in the epidermis into which it has burrowed, whereas the male can only, with difficulty, be discovered on the surface of the skin.

The full-sized female is visible to the naked eye as a white, semi-transparent speck. Under the microscope, it is seen to be oval in shape, slightly indented on either side, and about $\frac{1}{80}$th of an inch long by $\frac{1}{100}$th of an inch broad. Its convex dorsal surface is covered with little spines, while its flat ventral surface is characterised by wavy furrows running from side to side. The head is small and oval, and on it are minute hairlike processes. The legs, which are clearly seen on the ventral surface, are eight in number, four being situated anteriorly, near the head, the remaining four on the posterior half of the body. The front legs are short and broad, and provided with suckers; the posterior ones being slightly longer and narrower. Bristles are seen both on the body and on the legs. The male is much smaller than the female, has suckers on the hindermost pair of legs, between which are the organs of generation. Inside the cuniculus or burrow, the female acarus lays from twelve to twenty eggs, from which are hatched the young acari. At first they have but six legs, and only become fully developed after shedding their skins three times.

Malcolm Morris.

ACCOMMODATION OF THE EYE.

When the eye is completely at rest it is focussed for one definite distance only; that distance is called the *far point* (F). But it is well known that, during the greater part of life, we have the power of seeing distinctly, and therefore of focussing objects, at different and nearer distances. This is called the *Power of Accommodation.* The nearest point to our eyes for which we possess the power of accommodating is called the *near point* (N). It is evident that, other things being equal, it requires a stronger lens, or a stronger system of refractive media, to bend the rays proceeding from a point near the eye, sufficiently to bring them to a focus on the retina than is required to focus those coming from a more distant point. The *range of accommodation*, then, is given by the difference between the refractive power when the eye is accommodated for the near point, and when it is at rest or adapted for the far point. It is clear, therefore, that the range of accommodation is equivalent to, and may be expressed by, a lens the optical strength of which is equal to that difference. Such a lens, if placed in front of the eye *at rest*, would evidently give to rays proceeding from a point at a distance from the eye, equal to the distance of the near point (N), a direction similar to those proceeding from the far point (F). The eye being at rest, the rays would be focussed on the retina, so that the lens would take the place of accommodation.

The actual position of the near point will depend upon: 1. The range of accommodation; 2. The position of the far point. The first is evident from what has been said, and it need only be added that in all individuals the range of accommodation is approximately the same at the same age, though it varies very much with age; thus whilst at ten years of age it is equal to a lens of 14 dioptres; at forty it is only equal to one of 4·5 D, and at seventy-five is = 0. The far point, or the point for which the eye, when at rest, is focussed, cannot always be represented by an actual point in space; this can evidently only be the case when the far point lies at a *finite* distance *in front* of the eye, and is therefore one from which the rays are divergent as they enter the pupil, as in Myopia (*see* Refraction, Errors of). The ideal or emmetropic eye is focussed for a point the rays from which enter the pupil parallel to each other; such a point must be at an *infinite* distance, and has therefore no reality in existence, although the divergence in the case of rays whose base is the pupil and whose apex is a point at the distance of 20 feet, is so slight as to make them *practically* parallel. We have so far, then, two forms of eye, in one of which the rays from the far point are more or less appreciably divergent (myopic eyes), and in the other parallel (emmetropic eyes). But this does not exhaust the possibilities: one other form is met with, in which the rays, in order to be focussed by the eye at rest, must enter the pupil converging to each other, and therefore converging towards a point which lies at a finite distance *behind* the eye. In such eyes (hypermetropic eyes) the far point lies behind the eye, and is evidently not an actual, but only an imaginary, point.

From what has been said, it is evident that we may represent the *breadth* or *amplitude* of accommodation by the lens which brings the focus from the far point to infinity (∞), *plus* the lens which represents the difference between the refractive power for focussing an object at ∞ and that necessary for focussing one at the near point. The lens which brings the focus from F to ∞ is *practically* determined by the lens which, when the eye is at rest, gives the fullest possible acuity of vision at twenty feet (*see* Visual Acuity). In emmetropic eyes no lens is required; in myopic, a concave or *minus* lens; in hypermetropic, a convex or *plus* lens. As an example, take the lens bringing the focus from F to ∞ in three cases of Emmetropia, Myopia, and Hypermetropia, viz., 0. − 2·0 and + 2·0 (dioptres) respectively, and the lens giving the difference between ∞ and N in each case as 10·0, 12·0, and 8·0; we have for the breadth of accommodation (A)—

$$A = 10{\cdot}0 + 0 = 10\,\mathrm{E}.$$
$$A = 12{\cdot}0 + (-2{\cdot}0) = 10\,\mathrm{M}.$$
$$A = 8{\cdot}0 + 2{\cdot}0 = 10\,\mathrm{H}.$$

i.e., the *breadth of accommodation* is the same in all these cases, although the *near point* is different in each case, nearer than normal in myopia, and farther off in hypermetropia.

Mechanism.—The change produced in the refractive power of the eye, which brings about accommodation, is effected by the contraction of the ciliary muscle and the elasticity of the lens. On contraction of the muscle, the lens, more particularly in its anterior surface, assumes, owing to its elasticity, which comes into play when the tension on its capsule is reduced, a greater curvature, thereby increasing its refractive power. G. A. Berry.

ACCOMMODATION, Disorders of.—The change in the refracting power of the eye, produced by accommodation, may be looked upon as the result of the simultaneous action of two factors, the one a contraction of the ciliary muscle, and the other an alteration in the shape of the crystalline lens. This latter, which takes place in response to the diminished tension of the lens-capsule, a result of the contraction of the ciliary muscle, is the expression of the elasticity of the lens. The degree of perfection of the lenticular elasticity depends upon its structure and chemical constitution. The functional activity of either factor, in the production of accommodation, may be altered. The power of contraction in the ciliary muscle may be lost or impaired by atrophic or inflammatory changes, such as glaucoma, cyclitis, &c. Or, again, it may cease to be brought into play, owing to some interrupted function in the nervous mechanism with which it is supplied. On the other hand, a diseased state of the lens may diminish its elasticity; or disease of, or accident to, the zonule, alter or destroy the conditions by which, under normal circumstances, that elasticity responds to changes in the shape and position of the ciliary muscle when contracted. The lesion, giving rise to such an interruption, may be at a considerable distance from the muscle, and produce the functional disorders by interfering with the normal reflex mechanism giving rise to accommodation. Or it may exist at the centre, in the trunk of the third nerve, in the ciliary ganglion, or in the peripheral terminations of the ciliary nerves.

Paralysis.—All the conditions mentioned tend to diminish the amplitude of accommodation, or deprive the patient of the power of accommodating altogether. But the term *paresis* or *paralysis of accommodation* can only properly be applied to such cases as owe their origin to more or less impeded innervation. Some acute diseases are apt to be followed by more or less complete paralysis of accommodation, more especially diphtheria, and enteric and typhus fevers. Chronic diseases may also exhibit this symptom, such as syphilis, diabetes, various central and reflex nervous disorders, &c. Further, this form of paralysis is produced by some poisons, putrid fish or meat, and mydriatics (those principally employed in ophthalmic practice being atropine, homatropine, duboisine, daturine, and hyoscyamine).

The *diagnosis* of paresis of accommodation, if slight, is not always easy; but it is always to be suspected when there is pronounced diminution in the amplitude of accommodation, which should correspond to the age of the patient, provided, of course, the diminution is due to a recession of the near point, while the far point remains unaltered. Whenever distant vision remains unchanged, or, if improved at all, improved only by convex glasses, whilst distinct vision for near objects has suddenly become impossible, or rendered more difficult, then we may conclude there is more or less paresis of accommodation. Often, too, there is more or less mydriasis, which assists the diagnosis. Not infrequently children suddenly lose distinct vision for distant as well as near objects, owing to the paralysis of accommodation rendering an existing hypermetropia absolute.

The *treatment* should be general and tonic (according to the cause), and we may sometimes hasten a cure by the careful use of myotics; some believe, too, in faradisation and strychnia.

Spasm.—The amplitude of accommodation may also be diminished owing to *spasm of the ciliary muscle.* The spasm is either constant (a very rare condition), or occasional, and occurring during efforts of fixation. It generally occurs simultaneously in both eyes, rarely unilaterally. Spasm of the ciliary muscle occurs reflexly along with congestion myosis, and is excited by irritable states of the conjunctiva, cornea, and iris, and often associated with retinal hyperæsthesia. It is met with as a rare concurrence in some cases of errors of refraction and disturbances of the cervical sympathetic. Various toxic agents also bring about spasm of accommodation, principally the so-called myotics (those used for this purpose are eserine, pilocarpine, and muscarine). There is not much difficulty in diagnosing the condition. The diagnostic points are—abnormally small amplitude of accommodation, along with more or less myosis, and marked recession of the far point under the influence of mydriatics.

The treatment consists in keeping the eyes at rest: the removal of all sources of irritation, whether direct, indirect, or reflex; the use of mydriatics, and, if necessary, the accurate correction of errors of refraction.

It has been shown that in both paresis and spasm of accommodation therefore, there is to be found a diminution in the amplitude of accommodation. In paresis this is due to the recession of the near point, the far point remaining stationary; whilst in spasm the opposite takes place, the far point being brought closer to the near point, which here remains stationary (sometimes indeed approximating to the eyes slightly).

The effect of a weak myotic is often to increase the amplitude of accommodation, by increasing the contractile power of the muscle, allowing thereby the near point to approach more to the eye whilst, there being no actual spasm, the far point remains stationary.

The diminution of elasticity, as well as the change in the total refractive index of the lens, which begin at about the age of ten, and continue throughout life, both give rise to a gradual decrease in the amplitude of accommodation. When the amplitude has been reduced to an amount leaving a residue equivalent to a lens of less than 4·50 dioptres, the condition known as presbyopia or old vision is said to exist, a condition which, although in one sense a disorder of accommodation, is one which is in no respect pathological. *See* Presbyopia.

G. A. Berry.

ACEPHALO-CYST. *See* Hydatids.

ACHORION SCHÖNLEINII is the name given to the vegetable fungus which constitutes the greater part of the yellow crusts of favus. A small piece of the crust, treated with liquor potassæ, and examined under the microscope (magnified 500 diam.), shows the parasitic fungus to consist of spores and mycelium threads in great abundance. The spores consist of minute rounded bodies, the mycelium of long, narrow, thread-like tubes, which curve and branch in various directions. Some of the mycelium filaments appear to contain spores, while others are empty; free spores are also met with in abundance.

Robert Liveing.

ACHROMATOPSIA. *See* Colour-Blindness.

ACIDS, Swallowing of.—The only acids which, when swallowed, produce effects that are of surgical importance are the corrosive acids. The strong mineral acids (*sulphuric*, *nitric*, and *hydrochloric*) cause the most serious results. *Hydrofluoric acid*, which has been very rarely swallowed, also has a corrosive action, as have likewise *carbolic* and *oxalic* acids, but these latter are of more interest from their toxic, than from their traumatic, effects. Strong sulphuric acid, or oil of vitriol, is the acid which is most commonly taken. It may be deliberately swallowed with suicidal intent, or may be administered with murderous intent, or it may be swallowed accidentally in mistake for castor oil, or some other medicine or a liqueur. The result which follows on the swallowing of oil of vitriol, or other strong acid, depends more upon the concentration of the acid than the actual quantity taken. A teaspoonful of strong acid will produce results more serious than three or four times the quantity if previously diluted.

Symptoms.—Marks of the corrosive liquid are often seen at the angles of the mouth, and dirty white stains may be observable on the tongue and throat. There is at once a sharp burning taste in the mouth and throat, quickly followed by excruciating pain in the abdomen. The strong acid has a great affinity for water, and as it enters into combination with the water of the tissues, the heat evolved is intolerable. Vomiting is common in the early stages. The vomit is acid, and may cause effervescence if it fall on a limestone pavement. The patient is soon reduced to a state of collapse, which is extreme if perforation of the stomach takes place (*see* Collapse). There is usually constipation, but, exceptionally, there may be some tenesmus and passing of shreds of mucus, and small quantities of altered blood and similar matters, as well as the contents of the stomach, may also be vomited. The urine is usually diminished in quantity, and is loaded with sulphates when sulphuric acid has been taken.

The *prognosis* is always grave. It depends upon the amount and strength of the acid taken, and on the state of the stomach (whether full or empty) at the time. A small quantity of strong acid in an empty stomach is necessarily very likely to lead to perforation. When perforation occurs, death takes place within a few hours. If the air-passages are affected by the acid—if, for example, some finds its way to the glottic aperture—suffocation may soon follow the inflammatory swelling of the mucous membrane. If the stomach be not perforated, and if the air-passages escape, the patient lives longer. Death from collapse may occur, even though no perforation takes place. Death may result at a more remote period from inanition, resulting either from the destruction of the glandular structure of the stomach, or the occlusion of the œsophagus by the contraction of a cicatrix, the result of the corrosive action of the acid. *See* Œsophagus.

Treatment.—In treating these cases, it is very essential to bear in mind that the patient is necessarily in danger of perforation. The stomach-pump must *not* be used, nor any emetics be administered; but no time should be lost in endeavouring to neutralise the acid by the administration of alkalies. The carbonates of the alkalies should not be employed, lest the stomach, already in danger of perforation, be burst by the disengagement of carbonic acid gas. Calcined magnesia, stirred up with water or lime-water, or liquor potassæ, freely diluted, are the best antidotes. If these be not at hand, the plaster off the walls or ceiling may be given, powdered and suspended in water. If none of the alkalies are at hand, it is probably advisable to give the carbonates (e.g. washing soda), as the danger of keeping the acid undiluted is certainly greater than that arising from the disengagement of carbonic acid in the stomach. If neither the alkalies nor their carbonates be obtainable, the mere dilution of the acid may be aimed at. Copious draughts of milk, or milk and water, or even water alone, may be given; and oily or mucilaginous drinks are recommended as a protection to the coats of the stomach. If the patient be collapsed, it may be necessary, after the severe corrosive symptoms have subsided, to administer stimulants by the rectum.

The symptoms arising from taking the other corrosive acids are in the main so similar to those of sulphuric acid that it is hardly necessary to enter into the details again. Nitric acid, owing to the fact that it evolves irritating fumes, is very prone to attack the air-passages, and, after the corrosive symptoms as affecting the alimentary tract have subsided, the patient may succumb in the course of a few days to bronchopneumonia. Perforation does not occur quite so readily with nitric as with sulphuric acid. The nitric acid forms a tough yellow slough by its action on the mucous membrane. This separates after a few days, and the patient may vomit a cast of the œsophagus and stomach. This involves destruction of the glandular structure and ultimate death from inanition, if, indeed, perforation do not follow on the separation of the slough. G. V. Poore.

ACNE.—*Synonyms:* Acne vulgaris; Acne disseminata.

Definition.—Acne is a chronic disease of the skin, confined to the face, back, and shoulders. It is met with chiefly in young adults. The eruption consists of pimples, which are produced by an inflammation of the sebaceous glands and hair-follicles. The disease leaves small depressed scars.

Symptoms and Pathology. — Many qualifying names have been applied to common acne, such as 'simplex,' 'punctata,' 'indurata.' These names indicate the varying appearance of the eruption, and its different degrees of severity, rather than varieties of the disease.

Common acne is so constantly associated with comedones that it is almost impossible to deal with the two eruptions separately. A comedo consists of a hair-follicle, distended by a small mass of inspissated sebum mixed with *minute hairs*; these minute hairs are shed within the follicle, and in course of time accumulate in considerable numbers; they become matted together with sebum, and thus the natural escape of the sebaceous matter is prevented; a little black spot marks the orifice of the distended follicle. Subsequently inflammation occurs, and the comedo becomes converted into an acne pimple, which ultimately suppurates, discharges its contents, and heals with the formation of a small depressed scar. All acne pimples are not formed in this way, as inflammation may arise in the follicles without the previous formation of comedones; and, in very severe cases a more deep-seated inflammation occurs, producing a kind of blind boil which is very slow in suppurating. In theory, acne may appear on the skin of any part of the body, except the soles and palms, which are free from sebaceous glands and hairs; it is, however, rarely met with except on the face, neck, shoulders, back, and chest. Acne develops in successive crops which follow each other in quick succession, so that we see in any given case pimples in all stages of development and decay, from the early comedo to the final process of scarring; thus the *disease*, taken as a whole, is *chronic*, though the course of any one spot may be acute.

Etiology.—Acne, which is equally common in males and females, usually appears at the age of puberty, and arrives at its full development at about the age of eighteen or twenty; a few years later it has generally disappeared. In severe cases, however, it may continue to a much later period of life. It is met with, for the most part, in young people who have what is called a sluggish circulation, and who suffer from cold hands and feet, and sometimes chilblains. Acne is, moreover, much less troublesome in summer than in winter—indeed, it often disappears altogether during the height of summer, to return with the ensuing winter.

Varieties of Acne.—One variety of acne requires a brief notice. It apparently consists of groups of comedones, and is unattended with any *visible* inflammation; it is followed, however, by a very superficial kind of ulceration and scarring, giving to the skin an appearance which can best be described as a worm-eaten look. The scars are very shallow, clean cut, and different in appearance from those of ordinary acne.

Diagnosis.—The differential diagnosis of acne is usually very easy when the age of the patient and the history and distribution of the eruption are taken into consideration. The only eruptions with which it is at all likely to be confounded are (1) certain forms of dermato-syphilis, and (2) acne rosacea. The presence of comedones, and the absence of any symptoms of syphilis, will serve to separate it from the former, while the age of the patient and the absence of burning sensations and itching, will assist in distinguishing it from the latter.

Allied Diseases.—Certain eruptions allied to acne are usually classed with it—(1) acne artificialis, (2) acne varioliformis. The former of these is simply a convenient, though inexact, term for certain medical rashes resembling acne, such as those sometimes produced by bromide or iodide of potassium, or the local application of tar to the skin. Acne varioliformis is a rare, but well-defined, affection resembling acne; it is confined, for the most part, to the forehead and hairy scalp; the pustules, which are of uniform and rather large size, form scabs and deep scars like those of smallpox. This eruption is generally regarded as of syphilitic origin, and, without doubt, there is a form of dermato-syphilis which closely resembles it. But the eruption referred to is not a syphilitic one, as is shown by its occurrence in those who have never had syphilis, and also by the fact that it does not generally yield to anti-syphilitic remedies, but rather to large doses of arsenic. It is, however, a very obstinate affection.

Treatment.—An ordinary case of acne is best treated in the following manner:—A sulphur ointment (ʒj. to ℥j.) should be well rubbed on the skin affected every night; it should then be lightly wiped off, so as to allow only a small quantity of the ointment to remain on all night. In the morning the ointment should be washed off with a soft flesh-brush, soap, and warm water; if the skin is tender, a little starch powder may be applied to the face during the day. This plan of treatment must be continued for months or years according to circumstances. Instead of using an ointment, a drying sulphur lotion, containing a little ether and spirit, may be used, but very little of the sulphur in the form of powder should be allowed to remain on the face, otherwise it is apt to get into the eyes and produce irritation. When sulphur does not suit the skin, a weak soap lotion (soft soap ʒiij., proof spirit f℥viij.) may be applied every night, and a little allowed to dry on; this should be washed off in the morning with warm water in the usual way. In very severe cases of acne, the larger acne pimples should be lightly touched with a small blunt-pointed piece of wood, dipped in pure carbolic acid; this must be done carefully, so as not to allow the acid to run down the face; a few spots should be touched daily; this process causes the pimples to dry up, and thus tends to diminish the formation of deep scars. In most cases of acne, the administration of cod-liver oil during cold weather will be found beneficial. Small doses of arsenic are also sometimes useful.

Robert Liveing.

ACNE ROSACEA.—*Definition.*—Acne rosacea is a chronic disease of the skin of the face, a characteristic feature of which is a passive congestion of the vessels, associated with sensations of burning and itching and the formation of pimples.

Symptoms and Pathology.—Acne rosacea has little relation to acne vulgaris, except in name and appearance. The eruption, which is confined to the face, is met with chiefly in women of middle age. It has one feature in common with acne vulgaris, namely, its great tendency to appear in those whose cutaneous circulation is sluggish, that is, who suffer from cold hands and feet and passive venous congestion. Hence it is that those who have had acne vulgaris in early youth are very liable to acne rosacea in middle life.

It is usual to describe two forms of acne rosacea: (1) the *hypertrophic form*, which is comparatively rare and chiefly met with in men; and (2) the *non-hypertrophic form*, which is very common and almost confined to women. The former consists in an increased growth of the fibro-vascular tissue of the nose and adjacent skin of the face; in severe cases the nose is much enlarged, nodulated and red. This hypertrophy is generally associated with the development of acne-like pimples. The disease is often, but by no means always, the result of over-indulgence in alcohol. Long and frequent exposure to cold winds in those whose cutaneous circulation is feeble, is very apt to produce a similar result, though in a less degree.

The *non-hypertrophic* variety of acne rosacea is very common. In its mildest form it consists simply of a passive over-distension of the vessels of the skin of the nose and cheeks, forming a pretty well-defined symmetrical red patch; the congestion may vary much at different periods of the day, but is generally aggravated after a meal and during the evening. Besides the nose and cheeks, the chin and forehead are often affected. In a more advanced stage, the congestion becomes more persistent and small red pimples appear, resembling those of acne vulgaris. The eruption is almost always accompanied with sensations of burning and itching, especially the former.

Etiology.—One cause of acne rosacea has already been referred to. A much more common cause is chronic indigestion associated with a feeble circulation. It is not uncommon to find all the symptoms of the disease aggravated every month at the period of menstruation, and the age at which that function altogether ceases is especially liable to its attacks.

Diagnosis.—Acne rosacea is hardly likely to be mistaken for any other disease except acne vulgaris. The age of the patient, the congestion of the skin, and the subjective sensations which are almost always present, serve to distinguish it from the latter disease.

Treatment.—The treatment of the hypertrophic form of the disease consists in the free division of the vessels; this relieves the congestion, and at the same time gradually gets rid of the new vascular tissue; at the same time, complete abstinence from alcohol must be enjoined. The non-hypertrophic variety of the disease arises so often from indigestion, that the greatest attention should be given to diet, rest, and those medicines which are generally useful for improving the digestive powers. Mild saline purgatives are sometimes very beneficial, especially when the bowels are naturally constipated. The most generally useful local application is the ordinary calamine and oxide of zinc lotion, to which a small quantity of sulphur has been added. (Oxide of zinc, ʒij.; calamine, ʒij.; precipitated sulphur, ʒss.; rectified spirit, f℥ss.; glycerine, fʒij.; lime water, f℥ij., rose water to fʒviij.). Robert Liveing.

ACROCHORDON is a small outgrowth of the skin, consisting of a minute thread or cylinder of fine fibrous tissue, containing small vessels. When cut across, these vessels sometimes bleed freely. Acrochordon is met with chiefly on the loose skin of the neck. The treatment consists in snipping it off with a pair of scissors, and then lightly touching with caustic.

Robert Liveing.

ACROMION PROCESS, Fracture of the. *See* Scapula, Fracture of the.

ACUPUNCTURE may be performed, according to circumstances, with a round-pointed or sewing, or with a cutting-edged or surgical needle. Its uses are various: as a stimulant; as a counter-irritant; for the purpose of evacuating or dispersing fluids from various parts of the body; and the term may also be applied to the use of needles in the operation of tattooing, which is almost confined to ophthalmic practice. With regard to the use of acupuncture for the purpose of evacuating fluid in cases of anasarca, the practice is so well known as hardly to call for any remarks; and the same may be said with respect to its use in dispersing the contents of certain encysted collections of fluid, such as hydrocele and ganglia. In the latter case, however, a cutting-edged needle must be used to ensure a successful result; whereas in dropsy a round-pointed needle is sufficient, and in fact preferable, as being less likely to inflict injury upon the skin. But the term acupuncture is more generally applied to the use of needles for the relief of various painful affections, such as neuralgia, and muscular pain and stiffness consequent upon injury or chronic rheumatism. For this purpose the needles should be flexible, with handles or heads made of bone, glass, sealing-wax, or twisted wire; they should be introduced with a slight rotatory movement, or by a succession of light taps. This practice has for ages been popular amongst the Orientals, more especially the Chinese and Japanese, in whose hands the effects are said to be marvellous; but the records of English surgery do not throw much light upon the subject. It is true that its use in the treatment of obstinate sciatica is well recognised, but its success has been by no means constant. For this purpose the directions usually given are, that the tender part of the nerve having been ascertained by pressure, the needle is to be thrust in until it is felt by the patient to have entered the nerve, and there left for a few minutes. Erichsen says that five or six needles may be introduced at one operation. The mode of action is uncertain, but one explanation is that tension is relieved by the puncture of the nerve-sheath. In the recent edition of Agnew's *Surgery* (vol. ii. p. 265) is shown an instrument for producing superficial acupuncture in the treatment of local pains; but here the effect may be clearly defined as counter-irritant.

Regarding the use of acupuncture for the relief of chronic muscular pain and stiffness, more especially where arising from injury, probably the best account will be found in the *Lancet* for April 29, 1871, in a paper by Mr. Pridgin Teale, 'On the Relief of Pain and Muscular Disability by Acupuncture,' in which he relates several cases where the thrusting in of a needle in two or three places until the bone was touched, and leaving it there for a minute or two, was followed by complete cure in one instance, and relief in three or four more out of ten cases, and explains his view of the mode of action. Also Mr. Simeon Snell, of Sheffield, in the *Medical Times and Gazette* (June 9, 1880), relates several cases of loss of power of the deltoid, which he treated successfully in the same manner. Acupuncture has been used in the treatment of ununited fractures. Here the object is to set up irritation and increased vascularity, and the needles should be left in for several days. In a case related by Wiesel (mentioned in Holmes' *System of Surgery*), they were left in for six days, until they caused pain and swelling, and the result was successful. Malgaigne tried this plan, but unsuccessfully. The difficulty is to get the needles between the ends of the bone.

Lastly, acupuncture has been tried in the treatment of aneurism. Originally suggested by Velpeau, it was practised with a successful result by Benjamin Phillips, of London, in 1831, in a case of carotid aneurism. In more recent times (January 1879), it was tried by Mr. Christopher Heath, in a case of traumatic aneurism of the subclavian, where amputation at the shoulder-joint had failed. He 'introduced three pairs of sewing needles into the tumour, making each pair cross within the sac; they were not withdrawn until the fifth day, by which time considerable clotting had taken place.' The aneurism gradually became solid; but bronchitis supervened, and the patient sank seventeen days after the insertion of the needles. The post-mortem examination showed that the aneurism was cured, the sac being full of dense fibrin. Encouraged by the result in this case, the writer of this article tried the same plan in a case of aneurism at the root of the neck, occurring in a man thirty-three years of age, who was under his care in the Liverpool Northern Hospital, in the early part of 1880. Mr. Heath's plan was as nearly as possible carried out accurately; but as there was no apparent effect at the end of four or five days, other needles were inserted, as the first were withdrawn, but at different parts of the swelling. As each needle was withdrawn, a few drops of blood escaped from the puncture, which was at once covered with styptic colloid. This procedure was carried out for several weeks, with the result that the tumour became firmer and the pulsation feebler; then the aneurism became smaller, and finally almost disappeared behind the sternal end of the clavicle. Unfortunately, some chronic cellulitis had been set up by the needles, and just at the time when success seemed to have been attained, a slight sanio-purulent discharge occurred from one of the needle-holes which reopened. The same evening the temperature rose, vomiting occurred (evidently due to septicæmia), and as a result of the vomiting the sac must have given way, for the swelling suddenly became diffuse, and several of the needle-punctures reopened, giving vent to broken-down clot and fresh arterial blood, and, in the course of less than forty-eight hours after, the patient died. A post-mortem examination revealed an aneurism of the innominate artery, the collapsed sac of which would have contained a small hen's egg; this sac had evidently recently given way, and the aneurism had become diffuse, forming a large cavity in the lower part of the neck containing fluid blood, fresh clots, and one large mass of old and thoroughly organised hard clot which had obviously filled the true aneurism, and escaped when the rupture of the sac occurred. This case, together with Mr. Heath's, may be taken as evidence that acupuncture is worthy of consideration in suitable cases of aneurism; but the writer feels that his own case is furthermore a warning against pushing this treatment too far. It would be better to wait patiently the result of the first introduction of the needles before proceeding to insert others.

Acupuncture has also been used in the treatment of cirsoid aneurism, but as in most instances it has been tried in combination with the galvanic current, its use in such cases can hardly be considered here, although Professor Billroth, its principal advocate, attributes the success in his three cases of galvano-puncture to the acupuncture only. CHAUNCY PUZEY.

ADAMS'S OPERATION.—An operation for the subcutaneous division of the neck of the femur in cases of angular osseous ankylosis of the hip-joint. *See* HIP-DISEASE.

ADENIA. *See* LYMPHADENOMA.

ADENITIS. *See* LYMPHADENITIS.

ADENOMA.—An adenoma is an encapsuled tumour, containing in its structure the textures found in glands, and commonly those of a racemose gland, and it generally occupies a position on the periphery of one of the complex secreting glands, the mammary region being by far the most frequent site of adenomatous growths. Some of the prostatic enlargements are tumours of this kind, and occasionally they are found in the lips and cheeks. The parotid is a common position, but here adenomata not infrequently contain cartilage, as also do those which less frequently occur in the sub-maxillary region.

Cause.—No cause capable of demonstration can be assigned for the occurrence of adenomata. It has been suggested, from the circumstance of such tumours appearing, or rather taking on growth, during the period of functional activity in the adjacent gland, that they are congenital, having remained dormant during early life. Some force is lent to this suggestion by the fact that some of the mammary adenomata shrink and seem to disappear with the occurrence of atrophic changes in the mammary gland itself.

Pathology.—For a tumour growing in proximity to a gland to be regarded as an adenoma, it must possess the histological characters of gland-structure, and usually, as has been noticed, that of a racemose gland, with its grouping of acini, tubules, and lobules. *See* BREAST, Diseases of the.

Symptoms and Diagnosis.—These vary so entirely with the situation of the adenoma, that it is an impossibility to give any general description of the external characters of this class of tumour which should hold good for chronic mammary tumours, for an adenoma of the lip, or of the encysted tumours of the prostate. As the mammary region supplies the greater number of gland-tumours, a description of one of these will indicate the clinical features of adenoma sufficiently.

In size adenomata vary from a hazel-nut to a walnut, and are usually found in young unmarried women; they are rare after the age of forty. They are usually firm and irregularly ovoid; they do not adhere to the skin, or cause dimpling of it. They are very freely movable, but nevertheless are seemingly attached to the adjacent mammary gland. Sometimes they are contained within the substance of the gland, or cause a depression on its surface, and they rarely afford any feeling of fluid. When pain is complained of, it is usually paroxysmal or neuralgic, and there is frequently complaint of some increased fulness and tenderness at the menstrual periods. Often they remain stationary for years, and then enlarge, or with disappearance of the menstrual flux they may shrivel.

As a rule, the *diagnosis* is easy. A limited isolated tumour, not very hard and without lymphatic affection, can scarcely be taken for a carcinoma. Rarely is the sense of fluctuation obtained, but a quickly-growing adenoma in the substance of the breast may be mistaken for some one of the cyst-formations found in this organ. So, again, it may not be possible to tell before removal whether a tumour is a quickly-growing adenoma or a sarcoma.

In later life, however, it is not always easy by examination alone to say whether a firm swelling is an adenoma or a small circumscribed scirrhus-growth of a portion of the margin of the gland. Due attention to the duration, the age, and the history, will generally enable a correct diagnosis to be made.

Treatment.—If decidedly increasing in size, if disfiguring, if the pain is so great as to cause distress to the patient, or if the mental anxiety at discovering a tumour in the breast affects the health, it will be well to advise the removal of an adenoma. On the other hand, in the absence of any of these circumstances, the patient may be told that the growth is quite innocent in its nature, and that, so long as it is not a source of annoyance, there is no object to be gained by an operation. In these cases, and in others where the patient shrinks from an operation which the surgeon can seldom truthfully say is imperatively demanded, much relief may be obtained by insisting on the abandonment of all such dresses or other garments as press upon the tumour, and by protecting the part from ever-repeated self-examinations of the swelling, which only irritate the part and disquiet the mind; nothing answers this purpose better than a belladonna plaster, kept on for two or three weeks. Temporary restraint of the use of the arm by the adoption of a sling may be advised when there is shooting pain, referred, it is to be presumed, to the inner side of the arm. The patient should be strongly urged to dismiss all thoughts of the swelling from her mind. Of course, many points in the patient's general health may need attention, and signs of indigestion, habitual constipation, irregular, scanty, and painful menstruation, should be at once attended to. A. Willett.

ADHESION.—The growing together of living tissues, healthy or diseased. Physiological adhesion is the basis of reparative surgery; pathological adhesion is one of the most fertile and potent factors in the development of surgical complications.

Healthy adhesion of divided tissues is the continuous work of normal nutrition, commencing so soon as divided surfaces or parts are restored to, and maintained in, accurate contact. As divided parts approach most nearly to the state of health, their reunion is proportionately rapid, painless, and firm. Foreign bodies and impurities, tension and unrest, are causes of nervous and vascular irritation; and, to an equal extent, impediments to direct adhesion. This is illustrated in all the operations of plastic surgery, and generally in the healing of wounds, whether of the soft or hard parts. *See* Fractures; Wounds.

When the physiological standard is departed from, and excess of vascular and nutritive activity reaches the inflammatory stage, adhesion may still occur; and often does so, under those circumstances, to a very great extent. But adhesive inflammation is strictly a pathological process, and a cause of diseased conditions. Cicatrices, when adherent to subjacent parts, and especially to bone after amputation, are often causes of lifelong trouble. Injuries into, and in the neighbourhood of, joints, are followed by impairment of motion, in proportion as synovial membranes and tendinous sheaths become adherent. Bands and layers of lymph deposited within the abdomen are frequent causes of internal strangulation, and serious complications of ovarian and uterine disease. The ophthalmic surgeon also has abundant evidence of the mischief worked within the eye by pathological adhesion.

Nevertheless, the process of adhesion surpassing the physiological limits often has a preservative tendency, which the surgeon may utilise with the best results. Bullets and other foreign bodies which sometimes remain painlessly within the body for years, do so in virtue of the inflammatory process which they excite, and the adhesive products therefrom resulting. Internal abscess, aneurism, phlebitis, and ulceration may be rendered comparatively harmless by inflammatory adhesions. In arresting hæmorrhage from divided arteries, in treating intestinal wounds, in the radical cure of hernia, hydrocele, nævus, and varix, the surgeon relies on his power to produce inflammation, within the limits of adhesion. So directed and restricted, inflammatory adhesion is a therapeutic resource, often as beneficent and enduring as is painless and physiological adhesion.

Sampson Gamgee.

AINHUM.—This disease occurs in negroes, especially those of Brazil and Bahia. It affects the little toes chiefly, and appears to consist in a fatty degeneration of all the tissues, commencing without pain, and not affecting the general health. A groove gradually extends round the root of the toe; the parts beyond this are much increased in size, become looser and looser, and interfere with walking.

Treatment.—Amputation.

W. H. A. Jacobson.

AIR IN CELLULAR TISSUE. *See* Emphysema.

AIR IN VEINS.—*Pathology.*—The entrance of air into veins through a wound in their parietes is an exceedingly grave accident. The occurrence may give rise to a train of the most serious symptoms, or may lead to an almost sudden death. The air is drawn into the thorax through the wound in the vein by the inspiratory movement of the chest, just as it is drawn into the lung through the trachea. It enters the right auricle of the heart, and that cavity, after death, will be found to be quite distended by a frothy mixture of blood and air. The same froth will be found in the superior vena cava and the innominate veins. The air may make its way into the right ventricle, and a small quantity may even penetrate as far as the pulmonary artery and its branches. Death in these cases appears to be due to arrest of the pulmonary circulation and to interference with the heart's mechanism. For the proper working of the tricuspid and pulmonary valves it is necessary that the heart should be occupied by fluid blood. The valves cannot act in a mixture of air and blood, and with the cessation of their action the proper movement of the heart ceases. The circulation of blood through the lungs must be suddenly interrupted when this accident occurs, and as but little blood can reach the left ventricle, anæmia of the brain and of other parts must be produced.

The aspiratory effect of the thorax upon the venous circulation does not appear to extend beyond the vessels of the neck and axilla. The isolated cases, in which air is said to have been drawn into the thorax through wounds in such veins as the median basilic and the long saphenous, are open to considerable doubt. The cervical veins have been much more frequently the seat of this accident than the veins of the axilla.

That air may enter it is necessary that the vein be only partly divided, or, if entirely divided, that its lumen be kept open by the adhesion of the vein-walls to the adjacent parts. If a normal vein in the regions in question be entirely cut across, its limp walls are drawn together during an inspiratory movement and its lumen is more or less entirely closed. This closure is really effected by atmospheric pressure, and can be well seen in drawing air along a thin india-rubber tube, a part of whose wall has been divided. Veins whose walls are thickened are apt to favour the entrance of air, as are also such vessels as are bound up in inflammatory material or in the substance of a new growth. The external jugular vein, moreover, is so related to the cervical fascia, and the axillary vein to the costo-coracoid membrane, that these vessels remain patent when cut across. Often the dragging upon the parts, as in removing a tumour, is such as to make some of the veins that have been divided gape and remain open. The accident has occurred most frequently during the removal of tumours from the neck or axilla. It has happened also during amputation at the shoulder, resection of the scapula, ligature of the carotid and subclavian arteries, tracheotomy, venesection of the external jugular vein, and, in one recorded instance, during the introduction of a seton in the neck.

Symptoms.—The entrance of the air is marked by a very distinct hissing noise, precisely like that heard when air and water are being drawn up by a syringe. It must be especially noted that if any bubbles are seen about the wound they are caused, not by the air that is entering, but by the air that has escaped from the vein during the expiratory movement of the thorax. The patient, if not anæsthetised, is seized with a sudden terror; there is severe dyspnœa with hurried and violent inspirations; the action of the heart becomes irregular and often tumultuous; the pulse sinks, is most irregular, and often becomes rapidly imperceptible; the face is, as a rule, bluish at first and then becomes pale; there is more or less profound syncope, and in some cases there may be convulsions of a tetanic character or a violent cough. The dyspnœa is probably entirely due to the sudden interruption in the pulmonary circulation, while the faintness depends mainly upon the anæmia of the brain consequent upon the lack of blood in the left ventricle. About two-thirds of the patients thus affected die, the majority within a few minutes, the remainder after an interval of hours or even days. On the other hand, recovery has taken place, even after the symptoms have been very severe, and in a few instances no visible ill-effects have followed the accident, although the hissing noise was distinctly heard. Clinical experience, as well as vivisection experiment, appears to show that the fatal result depends rather upon the rapidity with which the air is introduced than upon the actual amount that enters, other things being equal.

Treatment.—It cannot be too constantly borne in mind that this accident can only occur in what may be termed dry wounds. The injured vein must be either exposed to the air or separated from the air by only a thin layer of blood; if the wound be full of blood the accident is impossible. As may be supposed, it occurs most usually when a tumour is being dragged from its attachments, or just after a deep incision has been well sponged out.

The moment the hissing sound is heard the wound should be filled with water squeezed from a sponge. This at once prevents the entrance of more air, and at the most the patient merely draws into the vein a little blood and water. It is useless at the first to attempt to tie the vein. The damaged vessel is not easy to find, and to apply a ligature takes time. Moreover, if the ligature be applied during an inspiration, it would certainly prevent the entrance of more air, but if applied during an expiration it would merely prevent the escape of such air as had already entered. To place the finger upon the divided vein during inspiration and remove it during expiration would not be bad practice. But here again comes the difficulty of recognising the damaged vein. The hissing sound is the only guide. There is nothing to be seen as the air enters. Any bubbles that are seen in the wound indicate the escape of air, and to place the finger over the spot where the bubbles are seen—as some advise—would be obviously bad practice. The filling of the wound with water is a ready and safe expedient, and, in all deep operations about the neck and axilla, the writer always has a sponge filled with water held ready, so that in a moment its contents can be squeezed into the wound.

The second step in the treatment of the accident is to endeavour to remove the air that has already entered the chest. This can be best effected by waiting until the next expiratory movement, and then bringing forcible pressure to bear upon the front of the thorax. The air so expressed bubbles up through the water or blood that still fills the wound, and is obviously unable to re-enter so long as the wound is protected in the way indicated. The ease with which a large quantity of air can be expressed from the chest during an expiration is remarkable, and especially in children. The relief given to even the most alarming symptoms is immediate and striking. When all the air has been expressed, the wounded vein should be seized—most conveniently with a pair of Spencer Wells' forceps—and either entirely divided or ligatured. The writer has recorded two cases (*Brit. Med. Journ.* June 30, 1883) where the treatment just detailed was carried out with complete success. The suggestion that the air should be sucked out of the auricle through a catheter passed down one of the main veins cannot be too strongly condemned. An almost equally objectionable practice is that of resorting to artificial respiration. There is no lack of air in the thorax, but indeed too much, and this mode of treatment could only have the effect of hastening a fatal issue. FREDERICK TREVES.

ALBINISM.—The absence of pigment from those parts of the body ordinarily coloured, e.g. the skin, hairs, and iris. The subject of this congenital defect is ordinarily termed an ALBINO.

ALBUGO.—A dense white opacity of the cornea, generally resulting from injury, especially burns with caustic lime.

ALBUMINOID DEGENERATION is a variety of retrogressive metamorphosis of the albuminous constituents of animal protoplasm, almost invariably consequent upon the cachectic condition produced by some wasting disease. It most frequently attacks the arterioles and small bloodvessels, then the spleen, liver, lymph-glands, intestine, kidney, heart, and muscles, while very rarely only one organ may be notably affected.

Etiology and Causation.—This change which, when once begun, is almost invariably fatally progressive, attacks individuals usually between the ages of 10–30 years, and more frequently those of the second decade, namely, 20–30 years. Further, males suffer much more frequently than females, a striking difference which may possibly be accounted for by the greater prevalence of syphilis among the male sex.

It is usually preceded by, if not always caused by, one of the following diseases:—Prolonged suppuration, chronic lung-disease, accompanied by suppuration (namely phthisis, bronchiectasis, chronic bronchitis), leukæmia, rickets, gout, simple new-growths (e.g. myxofibroma, &c.), and the following cachectic states. Syphilis (not only with osteitis, but also in cases of syphiloderma, and in the congenital as well as the acquired form of the disease), intermittent fever, and mercurial poisoning.

The most favourably received explanation of the mode in which this change in the tissues may be brought about, is that of Dr. Dickinson, namely, that the albuminoid condition is the result of a constant drain from the body (by the suppurative discharge) of the alkaline salts, notably the compounds of potassium. This theory is supported by many histo-chemical facts and analogies, and therefore is given here in the absence of fuller knowledge on the point. The development of the change, usually supposed to be slow, was shown by Cohnheim to be occasionally very rapid; thus he found it very extensively marked within three months of the infliction of the lesion which started the degenerative process.

Symptoms. — The symptoms directly due to interference with the functions of the various organs affected, are fairly marked, so as to enable us to distinguish them from those due to concurrent affections.

From the fact of the disease attacking the organs and tissues in the order given above, the following are the most marked symptoms:—*anæmia*, affecting the red corpuscles mainly, is rather rapidly developed, and then remains almost at an equilibrium, but increases slightly towards death; *hydræmia*, causing œdema of many parts, more especially the connective tissues of the lower limbs, sometimes invades the whole body in advanced cases, when albuminuria reveals the fact that the afferent arterioles and malpighian glomeruli in the kidney are practically *hors de combat.* Occasionally *ascites* is present, the serous effusion being increased by pressure of the enlarged liver upon the portal vein. *Hæmorrhages* may occur, and death has followed directly from hæmatemesis. *Pseudo-leukæmia* is commonly noted as a combination of the foregoing symptoms. *Tumours* of the organs most frequently affected—viz. the liver and spleen—are easily discovered and recognised by their even surface and outline; *pain* is produced in the abdomen by a little local peritonitis around the affected organs, which are commonly found covered with adhesions. The *appetite* fails, and sometimes *vomiting* is noted; the *excreta* are pale from the absence of *bile*, stinking, covered with mucus, and followed by much flatulent discharge of gases. This change does not give rise to any pyrexia.

Diagnosis is rendered easy by observing the concurrence of the above symptoms with one of the diseases noted as leading to the degenerative change in the tissues.

Prognosis is probably always hopeless.

Pathological Anatomy.—The degeneration in an early stage is found to cause the intima or internal coat of the arterioles to become thickened, structureless, hyaline, and brightly refracting, while in addition Kyber noticed the arterioles to be frequently varicose. In other vessels the middle muscular coat becomes similarly affected; in the capillaries, as may be well seen in the malpighian glomeruli, the whole bunch of vessels becomes gradually fused into a bright amorphous mass. The veins almost escape the change altogether. This distribution of the degeneration is well illustrated by the disease as it occurs in the liver, where the middle zone of each hepatic lobule (namely, that part of it which is supplied by the hepatic artery more especially), is found to be first the seat of the change.

In consequence of the above changes in the blood-vessels, an organ which is thus degenerated appears on section to be bloodless, the surface being dry and pale; owing to the physical properties of the degeneration product, the whole organ is, as a rule, enlarged, has a bright shining surface on section, and while frequently hard, is yet tough and resistant to reagents, the mass not being soluble in either acid or alkaline solutions, and not readily decomposed.

The proper gland-cells of an organ thus diseased are said by some to be unaffected by the change directly, but to undergo fatty degeneration and atrophy as a result of the ischæmia produced by the disease of the blood-vessels; but in many instances they can be seen to be involved in the general metamorphosis which eventually converts the whole tissue into an amorphous refractive mass. Chemically this product has been isolated as lardacein, which is not amyloid or starchy as supposed by Virchow and others, but is an albuminous substance recognised most easily by its physical properties and its reaction to iodine and methyl anilin violet. Thus, if the cut surfaces of an affected organ be washed with water, and then (for some minutes), with a solution in water containing ·5 per cent. of iodine, and 1·5 per cent. of iodide of potassium, the diseased portions will be coloured of a mahogany red colour quite different to the general yellow stain of the surrounding parts; and if, moreover, a 10 per cent. solution of sulphuric acid be added, the red staining of the diseased tissues will change to a dirty purple or violet tinge. When the affected tissue is stained with methyl violet, the diseased portion becomes red and the healthy part blue.

Treatment. — This must of course be first directed to the removal of the cause if possible, and in the mean time to endeavour to relieve the organs chiefly attacked, while the general strength is being maintained. Thus constipation and diarrhœa, &c., must be treated by appropriate drugs; the skin, often harsh and dry, must be excited by hot air baths and pilocarpine, in order to relieve the kidneys; in fact, vicarious action must be encouraged as far as possible. At the same time free oxygenation of the tissues must be provided for by proper change of air, and the drain of potassium salts met by the administration of the same in combination with peptonised albumen, or some similar vehicle, which will admit of their being rapidly and easily assimilated. Iodide of iron and carbonate of ammonia have been much recommended, and can do no harm.

The diet must be chosen so that as far as possible the alimentary canal, the submucous coat of which is attacked early in the disease, may be relieved. This will best be effected by the food being of a light nature, and in addition being partly peptonised or pancreatised beforehand. The former is less disagreeable often to the patient, who of course is subject at any moment to attacks of vomiting and dyspepsia. VICTOR HORSLEY.

ALBUMINURIA.—The form of albumin which appears in the urine is nearly always serum albumin; egg albumin, and a peculiar variety described by Bence Jones from a case of osteomalacia, have also been found, but only under very exceptional conditions, and are of little surgical importance.

The albumin may be derived (1) from the mucous membrane lining the urethra in front of the compressor urethræ muscle; (2) from the prostatic portion of the urethra, the neck of the bladder, and the bladder itself; and (3) from the ureters and the pelves of the kidneys, and the kidneys themselves. Further, in the female, a very considerable quantity may find its way into the urine from the neighbouring genital organs, especially in cases of leucorrhœa; and even in the male it is probable that from time to time small quantities of spermatic secretion containing albumin may be discharged with the urine.

Albumin present in the urine, and derived from the anterior portion of the urethra, points to some inflammation of the mucous membrane, either gonorrhœal or else catarrhal, due to stricture, the presence of papillary granulations, some neighbouring inflammation, or even a constitutional affection—syphilis, struma, tubercle, or gout—roused into activity by some accidental cause. This may be distinguished by its always being small in quantity, and by the fact that it is only present in the first portion of the urine passed; the urethra is washed clear by the stream flowing through, and if care is taken to keep the first ounce separate, the rest will be found free. Not infrequently, under these conditions, there are found in the urine long, semi-transparent, rolled-up threads, the so-called gonorrhœal casts.

The portion of the urethra lying behind the compressor urethræ muscle, belongs, surgically speaking, to the neck of the bladder; if a large amount of secretion collects anteriorly to this point, it flows out of the meatus urinarius, and is known as a gleet; if posteriorly, it flows back into the bladder, and becomes mixed with the urine. Under these circumstances, though the first portion of the urine passed contains the largest amount of albumin, and, perhaps, casts of the prostatic ducts and spermatozoa, the rest is not quite free; and, in addition, there are the ordinary symptoms of inflammation about the neck of the bladder—frequent micturition, strangury, especially at the end of micturition, pain in the perinæum, and, perhaps, just at the close, when the bladder is contracting, a few drops of blood.

If the source of the albumin is the mucous lining of the bladder itself, it is very rare for the urine not to show other changes in reaction, deposit, and microscopic characters. There may only be a slight cloud floating about, with a few mucous corpuscles and detached epithelial cells visible under the microscope; or the urine may be foul and offensive, alkaline, partly from the amount of alkaline mucus added, partly from the decomposition of urea, with a thick, dense, gelatinous deposit of muco-pus mixed with triple phosphate crystals forming slowly at the bottom of the vessel, and, when this is inverted, falling out in a tenacious slimy mass.

It occasionally happens that this deposit of muco-purulent matter occurs in acid urine, of course unmixed then with crystals; no casts can be found; the urine remains acid, in spite of the large amount of alkaline mucus added; frequent micturition may be present, because the urine is no longer in normal relation with the bladder, but there is no strangury, showing that the neck of the bladder is not inflamed. Under these conditions it is to be suspected that the pus may come from the pelvis of the kidney, and that not improbably the whole of that organ may be disorganised, and consist of nothing but a greasy, yellowish-white, tenacious mass, enclosed by the capsule, on the inner side of which some shreds of cortex may still persist—strumous pyelitis.

Calculous pyelitis, and surgical kidney causing albuminuria, may be, in general, distinguished by the other changes that take place in the urine simultaneously, the occasional presence of blood, the altered reaction, the amount of albumin, and the presence of tube-casts, showing that the secreting structure of the kidney itself is involved.

Albuminuria, further, is nearly always present, and is of very great surgical importance, in organic disease of the kidneys—amyloid, large, white, or the small contracted granular form—and the diagnosis must be made from a consideration of the cause, from the amount of urine passed, the specific gravity, the evidence of amyloid disease elsewhere, the condition of the organs of circulation, and the presence and character of the tube-casts.

Besides these causes, albumin may make its appearance in the urine from disturbance of the circulation through the kidney, not merely from passive congestion, as in heart-disease, but probably through interference with the vaso-motor nerves. At least, it seems most easy in this way to explain the occasional occurrence of albuminuria and even hæmaturia after injuries to the head or the spine, and after the administration of certain drugs. Whether there can be any connection between these facts and the frequency of renal degeneration in patients suffering from abdominal tumours, is uncertain.

Albuminuria, then, is to be regarded as a symptom indicative either of some abnormal condition of the genito-urinary tract, or of some alteration in the composition of the blood, and a diagnosis must be made of the cause of its appearance from its character and quantity, and from the other features presented by the urine. When it has gone on for any length of time, no matter what the cause, it is always of very serious import in prognosis; the general nutrition suffers in direct proportion to the amount of the loss, and anæmia, emaciation, weakness, and inability to resist depressing agencies, increase *pari passu.* This is to be regarded as of no less importance in renal disease than the defective elimination of effete material; in genuine contracting disease of the kidney, with little loss of albumin, the normal colour and plumpness are long retained.

Albuminuria is of such importance with regard to surgical operations, that it should be held as a rule from which no deviation is to be allowed, that the patient's urine should always be tested on the morning of an operation, and, if possible, several times before. Nor should the urine passed on rising only be made use of—the urina sanguinis—but that also which is passed at intervals throughout the twenty-four hours. If the albumin is a mere accidental admixture from the neighbouring genital organs, or if it comes from the urethra or neck of the bladder, and the operation is one devised for the purpose of removing the cause, of course it has little to do with the question of prognosis. But if it points to the presence of cystitis, or, even worse, disease of the kidneys, at once it becomes an exceedingly serious element. This is true, not only of the presence of albumin in the urine, but also if the specific gravity is low and the urea percentage habitually below normal. The writer has more than once seen patients whose urine presented these two conditions without albumin being present, suddenly, after an operation, excrete a large quantity, probably owing to a certain amount of fever.

Operations, in general, are affected, as regards prognosis, in two ways. In the first place, there is a very considerable loss of strength represented by the loss of so much albumin; and, secondly, if of any severity, a great amount of strain is thrown on organs already partly incapacitated by the extra quantity of waste developed in the system. But besides these two conditions, both of which are sufficiently serious, the genito-urinary tracts are so closely bound up with the kidneys by means of the nervous system, that if the latter are diseased it is highly probable that any operation on the former, even the passing of a catheter, will cause partial, or even complete, suppression of urine. This, in all probability, arises from congestion being set up in inflamed organs which are only just able to do their work under normal conditions, and is effected in some reflex manner through the nervous system.

Albuminuria, arising from amyloid disease of the kidneys, is, in some respects, peculiar. It may usually be diagnosed by the early occurrence of polyuria, and by the presence of waxy degeneration of other organs; and there can be no question that there is a possibility, if not of complete recovery, at least of cessation of progress of the disease, if the exciting cause of the amyloid change be removed sufficiently early. *See* URINE; UREA.

C. MANSELL MOULLIN.

ALKALIES, Swallowing of.—The caustic alkalies are not so frequently swallowed as are the acids. Potash, soda, and ammonia have each proved fatal. Like the acids, the danger depends more upon the concentration than the actual amount taken. The symptoms are those of a corrosive poison—abdominal pain, vomiting, thirst, followed by collapse. The vomit is alkaline, and is often soapy in character, with much ropy mucus. Perforation of the stomach is not so common as with the corrosive acids, but, nevertheless, may occur. The liquor potassæ of the Pharmacopœia has been taken by mistake, but the most common accident has been the swallowing of soap-lees by those employed in soap-works.

The *treatment* consists in the neutralisation of the alkali by the administration of dilute acids, vinegar, very dilute mineral acids, or citric or tartaric if these be not at hand. The juice of acid fruits, such as lemons, or even oranges, if given in large quantities, may be of service. The employment of the stomach-pump is not advisable, owing to the danger of perforating the softened mucous membrane. It may be advisable to give stimulants per rectum. Death may result at a more remote period from inanition, owing to the destruction of the glandular surface of the stomach, or by the occurrence of stricture of the œsophagus from contraction of the cicatrix, which is the result of the corrosion.

If the alkaline corrosives enter the air-passages, death may result (as with the acids) from suffocation.

The volatile alkali (ammonia), like the volatile acid, is very apt to affect the air-passages, owing to the inhalation of the caustic vapour, and in this case the patient dies from capillary bronchitis, with some patches of pneumonia. Ammonia sometimes has the effect of producing a false membrane on the trachea and bronchial tubes, which to the naked eye is indistinguishable from a diphtheritic membrane. Cases are on record of death being caused (in persons already much enfeebled) by the mere inhalation of ammoniacal vapour, owing to the incautious use of the strong ammoniacal solution as a 'smelling-salt' for restorative purposes. G. V. Poore.

ALLARTON'S OPERATION. — A modern form of median lithotomy. *See* Lithotomy.

ALOPECIA AREATA.—*Definition.*—Alopecia areata is a non-contagious atrophic disease of the hair, a chief feature of which is the rapid formation of smooth bald patches on the scalp or other hairy parts of the body.

Symptoms.—Although alopecia areata is chiefly met with on the scalp, yet it is not uncommon on the eyebrows and beard. In extreme cases the whole body is affected, and becomes completely denuded of hair. The disease is sometimes unilateral, but more frequently it is roughly symmetrical. The regions of the scalp most often affected are the lower occipital, where the scalp joins the skin of the neck, and the part behind the ears. The eyebrows are often shed, and when this is the case, the outer part generally goes first. The parts attacked are usually quite denuded of hair, with the exception perhaps of the margin, where a few stumps may sometimes be found. This abrupt contrast between the smooth white bald patch and surrounding luxuriant hair, gives to the disease its peculiar and characteristic appearance. In an early stage of the malady, the bald patch is sometimes pinker than the surrounding skin, but much more commonly it is of the same colour or paler. A loss of sensibility over the patch is rare, yet sufficiently common to have been noted by many observers. In most cases there is a complete absence of subjective sensations; in some, however, there is neuralgic pain, and in others a tenderness on pressure. One of the most remarkable features of the disease is its almost sudden onset without any very apparent cause. It is very chronic, often lasting for years, and is also very apt to recur, so that it is not uncommon to find adult patients suffering from their second, third, or even fourth attack.

Etiology and Pathology.—The causes of area are at present unknown. It is more common in the young than in the old, and is probably equally common in males and females. It is met with more frequently in England than on the continent of Europe. The belief in the parasitic origin of the disease has been completely abandoned by all competent observers, partly because the clinical features of the disease cannot be explained on this supposition, but still more from the fact that no one has been able to demonstrate the parasite under the microscope. The origin of the disease is probably due to nerve-disturbance, causing impaired nutrition and subsequent atrophy of the roots of the hairs, and sometimes also of the skin itself.

Diagnosis.—The only disease with which alopecia areata is confounded is tinea tonsurans. In doubtful cases the examination of the stumpy hairs under the microscope, will generally determine the point. There are, however, some instances of tinea tonsurans in which the diseased patches rapidly become bald and assume the appearance of alopecia areata; this change sometimes occurs naturally, and at other times is the result of treatment; in either case the differential diagnosis may be difficult, unless the history of the case is carefully investigated.

Treatment. — The treatment of this disease is not very satisfactory. Tonics, good food, and change of air are beneficial. Local remedies consist in stimulating lotions, the best of which are the various preparations of cantharides, especially the acetum cantharidis diluted with spirits of wine. It is, on the whole, better to use a preparation not quite strong enough to blister, so that it may be applied daily.

Robert Liveing.

ALTERNATING CALCULUS. *See* Calculus, Urinary.

ALVEOLAR ABSCESS occurs in both jaws, as the result of inflammation connected with the teeth and originating in the socket. The earliest symptom is pain, with slight protrusion of the tooth, due to the inflamed condition of the membranes covering the tooth and lining the alveolus. If not relieved by judicious leeching or incision, matter forms in the socket, and either finds its way out by the side of the tooth, which is necessarily loosened, or, after causing great pain for a day or two, perforates the alveolus, and finds its way beneath the gum. This is the ordinary form of 'gum-boil,' which breaks spontaneously and after causing much suffering, unless previously relieved by a timely incision or extraction of the tooth.

The propriety of an early and free incision through the gum on to the alveolus is to be strongly insisted on, since necrosis and consequent exfoliation of large portions of the jaw not unfrequently follow neglect or postponement of the operation. Extraction of the tooth alone is not sufficient where the alveolus has been perforated, and in many cases the incision will serve to preserve a useful, though dead, tooth for many years. A wound of the facial artery has been met with from the edge of the knife being turned towards the soft tissues instead of against the alveolus.

But alveolar abscess does not always point within the mouth. The perforation of the alveolus may take place beyond the line of reflection of the buccal mucous membrane, and then the matter has to find its way to the nearest skin. In this way abscesses, with their resulting fistulæ, may be seen on any part of the face or neck, and occasionally grave errors of diagnosis are made from non-recognition of the fact that alveolar abscesses may burrow for long distances. The writer has known one instance of fatal suppuration between the muscles of the neck, leading eventually to suffocation, due entirely to mischief around a molar tooth in a patient whose health was undermined by drink.

In the case of the upper jaw, abscess connected with the incisor teeth not unfrequently finds its way backwards along the hard palate, and occasionally, but more rarely, into the nostril, being then liable to be mistaken for discharge from the nose itself or from the antrum.

Christopher Heath.

ALVEOLAR CANCER.—A term applied to colloid cancer. *See* Carcinoma.

ALVEOLAR SARCOMA. *See* Sarcoma.

ALVEOLUS, Fracture of the.—This is a frequent accompaniment of tooth-extraction even in the most skilful hands, and depends for the most part upon the divergence of the fangs of the teeth, by which extraction is rendered difficult. The operator may or may not be conscious that the alveolus is yielding to the pressure of the forceps, but upon the extraction of the tooth finds a portion of the outer plate of the alveolus loose beneath the gum. This need give rise to no uneasiness unless very extensive, since reunion of the fragment often takes place readily, or, at the worst, the portion detached becomes necrosed and exfoliates in the ordinary way. It is well to press together the margins of the alveolus in all cases of extraction, but when a distinct fracture has occurred caution must be used lest the fragment should be forced through the gum.

Christopher Heath.

AMAUROSIS.—The term amaurosis was formerly applied to all those cases in which the patient complained of complete loss of vision, whilst there was no apparent disease of the eye except that the pupil was dilated and remained motionless under the stimulus of light. It was synonymous therefore, in a large number of cases, with what is now called white atrophy of the optic nerve with cupping of the disk, which is most frequently the sequel of glaucoma; but other conditions were included in it, so that upwards of thirty varieties, distinguished by their real or supposed origin, or by some associated symptoms, were admitted and described by the older authors. Yet in some modern works upon the eye the term amaurosis is hardly so much as mentioned;

no chapter is devoted to its consideration, and most of the diseases once included in it, being easily recognised and discriminated from each other by the practised eye, are now discussed under separate headings. The uncertainty attached to its meaning has frequently led to its employment with the addition of some qualifying epithet, such as 'complete' or 'partial,' or 'unilateral' or 'hemianopic,' but it is properly restricted at the present time to those cases of total blindness which are associated with atrophy of the optic nerve without cupping of the disk, and to those cases of loss of vision in which the most careful examination, with all the advantages resulting from improved methods of research, fail to reveal any physical changes in the media or tunics of the eye. In all instances the function of the retina and optic nerve must be entirely abolished, or the case becomes one of mere dulness of vision, the causes and varieties of which will be considered under the head of AMBLYOPIA.

Etiology.—If a typical case of amaurosis be placed before the ophthalmic surgeon—one, that is to say, in which there is total loss of vision whilst the optic disk is of a dead white colour—and he is asked what may have led to this condition, many causes present themselves to his mind. Amongst these are surgical injuries, such as contusions of the eyes from blows with balls, champagne or soda-water corks; lesions of the globe or of the optic nerves, tracts, and centres from the entrance of foreign bodies, as in gunshot wounds; compression of the nerve in the optic foramen, owing to fracture of the bone or to periostitis; or similar pressure exerted by effusions of lymph, blood, or pus, as in the atrophy that occurs after capsulitis and inflammation of the cellular tissue of the orbit, which may be either primary or an extension of erysipelas of the face. Pressure on the nerve may also be exerted by thrombosis and by aneurism of some branch of the ophthalmic artery, or the nerve may receive an insufficient supply of nourishment owing to embolism of the arteria centralis retinæ; or there may be disease of the central nervous apparatus affecting the corpora quadrigemina, optic thalamus, cortex cerebri, or spinal cord. Again, meningitis, congenital malformation of the skull and hyperostosis, or imperfect development of the brain may be present.

Amaurosis may also be the result of causes affecting the metabolism of the system generally and of the nervous system in particular, as in the cases which follow typhus, scarlet fever, diphtheria, or other exanthem. It may be a symptom of Bright's disease, or proceed from the administration of large doses of quinine, or from the abuse of alcohol or tobacco, or from exposure to the injurious action of lead; from sexual excesses, or—which is perhaps of most common occurrence—proceed from syphilis. It has been known to follow the suppression of habitual discharges and the sudden arrest of the catamenia, and many instances have been recorded of its occurrence as a symptom of hysteria and of epilepsy. It has occasionally been observed to arise from reflex irritation, as in dental disease, especially when inducing suppuration in the antrum of Highmore, from worms in the alimentary canal, and from comparatively slight blows causing lesion of the branches of the fifth pair of nerves distributed to the brow, face, and temple.

In regard to this last point, without denying that a contusion of the supraorbital nerves, or their division and subsequent implication in the cicatrix, might lead to reflex amaurosis, it may safely be stated that some of the recorded cases, if they had been examined by means of the ophthalmoscope, would have exhibited visible lesions sufficient to account for the sudden accession of blindness, such, for example, as hæmorrhage into the vitreous, or detachment of the retina; or in cases where the onset of the disease was slower, progressive white atrophy with or without optic neuritis.

Lastly, amaurosis sometimes only temporary but at other times persistent, has been noted as a result of severe hæmorrhages.

The conditions which may lead to amaurosis are thus seen to be sufficiently numerous and diverse, and there are still other cases, of the cause of which no satisfactory explanation can be afforded. It is probable, however, that the history of the case, with a careful consideration of the collateral symptoms, especially of those presented by the nervo-muscular apparatus, will, in most instances, enable the locality, if not the precise nature, of the primary affection to be determined with some approach to precision, even in cases where the exterior of the eye appears to be normal.

Some of the forms of amaurosis mentioned above are very slow in their progress, and, as in the case of alcoholic and tobacco amaurosis, rarely proceed to complete loss of vision, so that their description is relegated to the article AMBLYOPIA.

Symptoms.—The symptoms in a typical case of amaurosis may be divided into the objective and the subjective. The objective symptoms are the dilatation, not generally extreme, of the pupil, with immobility of the iris when light falls suddenly and directly upon the eye. It is well to note, however, that if the amaurosis be unilateral, associated movements of contraction and dilatation may sometimes be observed in the affected eye when the sound one is exposed to the alternate play of light and shade, and that contraction may also occur as an associated movement when the eyes are made to converge in accommodation—a condition, sometimes termed the Argyll-Robertson symptom. from that surgeon having first noticed its occurrence. The eyes are often otherwise natural in brightness, in size, in form, in colour, and even in their tension, though this is generally and sometimes considerably increased ; and in the earlier periods of the disease, whatever may be its origin, they may move symmetrically.

The gait of the patient, and the expression, or rather absence of expression, in the face, are characteristic. The head is carried erect, and the elevated eyes seem as it were to search for light, in marked contrast to the lowered head, shaded eyes, and cautious step of the cataractous patient. The eyes gazing into vacancy, with their visual axes parallel, present a persistent unmeaning stare, which is well known and cannot be easily imitated. Oblique illumination reveals nothing except the immobility of the pupil and the absence of any reflex movements of the lids when a strong light is thrown upon the eye. Ophthalmoscopic examination demonstrates, in the great majority of cases, that the media are clear, and that the choroid and retina present little or no indication of disease. The only part which has undergone conspicuous change is the optic papilla, though in some cases even this is unaltered. Usually, however, it is seen to be well-defined at the margins, and, of various degrees of whiteness, from a pallor that is within physiological limits to an intense porcelanous or bluish whiteness. The retinal vessels are sometimes small, straight, attenuated, and greatly reduced in number, whilst at others they preserve almost their natural size and characters. In some instances, indications of optic neuritis and retinal and choroidal changes may be seen in the immediate vicinity of the disk.

The subjective symptoms are—loss of vision, freedom from pain, and an incapacity of the retina to respond to any stimulus—luminous, mechanical, or electrical. Hence the brightest illumination, such as exposure to the sun, fails to awaken any sensation of light ; and none of those luminous rings can be perceived, which are produced in the healthy eye by pressure on the globe, and which have received the name of phosphenes.

Treatment.—In regard to the treatment of amaurosis, much must depend upon the sagacity of the surgeon in discovering its cause. The numerous remedies which were formerly recommended as a consequence of the ignorance which prevailed in regard to the etiology of the disease and the physical conditions that were present, have successively fallen into disrepute, and their ill-directed use in pre-ophthalmoscopic times has given place to an apathy which neglects all means of cure. Yet it is possible that in some cases, especially in those which occur after fevers, the administration of appropriate remedies might be attended with improvement if not with perfect restoration of vision. It is certain that the most complete white atrophy does not preclude the possession of a very considerable amount of vision, and no forecast can therefore be founded upon this symptom alone. As a rule the employment of strychnia may be recommended, which may be administered in doses of ten minims of the solution, or it may be subcutaneously injected in quantities commencing with one-twenty-fifth of a grain daily or three times a week, rising gradually to one-tenth of a grain, repeated with equal or greater frequency. Larger doses are not in general well borne, the patients complaining of giddiness and twitchings of the muscles. Iron may with advantage be conjoined with the strychnia, and when these remedies fail, sulphate of zinc or of copper in doses of from one-quarter to one grain. Arsenic in ordinary doses, and gold cyanide in doses of one-eighteenth grain, may be given. As a rule iodide of potassium and mercury, in any mode of administration, are without effect, and indeed, when vision is not wholly abolished, appear, by depressing the patient, to do more harm than good. When white atrophy is fully established, the time for their employment is past. The same may be said of all local depletory measures, such as leeches, blisters, setons, and issues. The general health should be attended to, good diet prescribed, and attention to the bowels enjoined, and the respiratory and circulatory functions promoted by baths, exercise, and change of air. Without going so far as to state that electricity, whether employed in the form of the constant or of the interrupted current, is never successful, it may fairly be said that it has been often tried and has often failed. If employed it will be found that the constant current is more effective than the interrupted.

For Simulated Amaurosis *see* Vision, Feigned Disorders of. Henry Power.

AMAZIA, or Complete Absence of the Mamma, is very rare. It has usually been associated with absence or imperfect development of the pectoralis major, and sometimes of some of the ribs on the side on which the gland was wanting. A rudimentary condition of the breast in the female, resembling that of the male, has been met with in conjunction with congenital absence of the ovaries.

Marcus Beck.

AMBLYOPIA.—The term amblyopia signifies dimness, dulness, or indistinctness of vision, a condition that may arise from many causes. In the first place the media may be cloudy, preventing more or less completely the access of light to the retina. Secondly, although the media may be clear, their refractive power may be at fault; parallel rays of light when the eye is at rest being brought to a focus in front of the retina, as in myopia; behind it, as in hypermetropia; or meeting in different foci in different meridians, as in astigmatism; in each case causing the image formed on the retina to be blurred and indistinct. Thirdly, although the image is perfectly well defined on the retina, this organ may, as the result of some structural defect proceeding from imperfect development, inflammation, non-use, or other cause, be unable to convert luminous waves into nervous impulses, and even if such conversion occur, the optic nerves and tracts may be incapable of transmitting the impulses generated to the brain. Lastly, although all conditions requisite for clear vision may, so far as the eye is concerned, exist, the central nervous apparatus may be the seat of some lesion that renders it incapable of appreciating and responding to the impressions transmitted to it by the optic nerves. Each of these forms of amblyopia requires brief consideration.

In England there do not appear to be any precise instructions issued to guide the examiners in determining what degree of impairment of vision should exist to cause rejection for the naval and military services; but in France, M. Barthélemy states that for admission into the army a recruit must see $\frac{25}{100}$, or $\frac{1}{4}$th the normal, with the right eye, and $\frac{8\cdot5}{100}$, or $\frac{1}{12}$th, with the left eye, whilst for the inscription or for the marines it must be $\frac{50}{100}$ at least.

This is not altogether an arbitrary limit, but is in relation with the ordinary conditions of military life; for it is clearly essential that, as M. Barthélemy observes, a soldier should be able to distinguish a sentinel, a man on horseback, a group of men, count the files of a squadron, judge of their state of repose or movement, their line of march, and the like, at a distance of at least 250 to 300 yards. He must be able to take effective aim at about the same distance, but the body of a man having a height of 5 feet, and a breadth of 12 to 15 inches, is easily distinguished at a distance of from 1,200 to 1,400 yards by a normal eye, and would therefore be still seen at 300 yards by an eye that had lost three-fourths of its visual power, at a distance at which the fire of a rifleman is highly effective.

For amblyopia due to cloudy media and diseases of the optic nerve and retina, see articles Cornea; Crystalline Lens; Vitreous, Diseases of the; Optic Nerve; Retina, Affections of the; Choroid, Diseases of the.

Amblyopia ex Anopsia is a term that has been applied to those cases where the dimness of vision is simply the result of disuse. This condition is familiar to ophthalmic surgeons in cases of squint, but is also observed in cases of congenital cataract, of leucoma, and of other affections in which the access of light is prevented or interfered with. In those cases of squint where the only defect is some error of refraction, the images of external objects, when the affected eye is at rest, are dim and indistinct, and little attention is paid to them, and if, as in hypermetropia, clear vision can only be obtained by a strong effort of the accommodative power for a short time, the internal recti soon become fatigued, the convergence of the eyes can no longer be maintained, and one eye wanders from the point of fixation. In some instances the patient uses the eyes alternately, and then good vision may be preserved in both; but in many cases a preference is given to one eye; the impressions made upon the other are then less and less attended to, and finally, in a few rare cases, the torpor or inactivity of the receptive apparatus in the eye, or of the percipient cells in the brain, becomes so marked that the largest objects can scarcely be discerned, and vision is reduced to little more than the mere perception of light. In such cases the most careful ophthalmoscopic examination fails to reveal any definite change in the optic disk, retina, or retinal vessels, and the proof that no serious organic alteration of structure has been produced is derived from the fact that by practice, when appropriate glasses are supplied, or the cataract removed, or when—as in cases of leucoma—an iridectomy has been performed, and clear images are once more thrown upon the retina, it resumes its former functions, and in course of time the vision may become perfect, the recovery being, in general, earlier and more complete the shorter the time that has elapsed since the eye has been disused. Hence, cases of strabismus should be placed under treatment as soon as the defect is observed, and the operation for congenital cataract should not be postponed, on this as well as on other accounts, providing there is no contraindication, for more than the second or third year, a time of life when it is generally successful.

Amblyopia seems to arise occasionally from masturbation in both sexes, and scattered notices of its occurrence may be met with in books and occur in practice. It is most common between the ages of fifteen and twenty-five, but may, of course, occur at a later period.

AMBLYOPIA FROM EXPOSURE TO BRIGHT LIGHT.—Impairment of vision has been observed in those who have incautiously gazed at the sun, especially through a telescope, in those who have looked intently at the electric light, and in those who have been long exposed to the bright reflection of light from snow. Newton is well known to have suffered from scotomata through life, after a momentary glimpse of the sun through his telescope; and Deutschmann has shown that, when the rays of the sun are concentrated on the eye of a rabbit, serious and persistent lesions are produced, the retinal albumen becoming coagulated, and great vascular disturbance—indicated by congestion, diapedesis of blood-corpuscles, and dislocation of the pigment—being set up. A case of temporary amblyopia, after long inspection of the electric light, in a young telegraph engineer, was seen by the writer. There was some peripapillary œdema; rest effected a cure. In snow-blindness the impairment of vision usually soon disappears with removal of the cause.

Various cases of reflex amblyopia have been published, as after a vaginal injection which caused severe pain (Priestley Smith, *Ophth. Rev.*, Jan. 1884), apparently from thrombosis of the retinal artery.

NYCTALOPIA.—Amblyopia, in the form of night-blindness, is often associated with physical changes in the retina, and especially with pigmentary deposits in the form of patches, fine striæ, plexuses and stellæ, which in many cases run parallel to, or are in close contiguity with, the retinal vessels. This form of amblyopia has been frequently noticed as a result of scurvy, and several instances have been recorded by Dr. Alexander Bryson in the second volume of the Ophthalmic Hospital Reports. As a rule, the prognosis in nyctalopia, unless *retinitis pigmentosa* is present, is favourable, and recovery usually follows rest of the eyes, good food, and the administration of tonics.

1. CEREBRAL AMBLYOPIA.—In a certain number of cases impairment of vision results from some lesion of the cerebral extremity of the nerves. In some instances the lesion is congenital, and consists in an imperfect development of the visual centres—whether optic thalami, corpora quadrigemina, or occipital lobes depends upon circumstances. It is then often associated with nystagmus. The same symptoms are observed in children who are suffering from hydrocephalus. It is sometimes seen as the result of uræmic poisoning, unattended with notable physical change in the retina or disk. It has been surmised that in these cases effusion into the corpora quadrigemina has taken place, and the blindness has, in some fortunate instances, proved transitory. It may result from simple anæmia of the centres, and the darkness that is felt just before swooning is of this nature. It may be a consequence of the growth of tumours or other coarse disease of the brain, as has been well shown by Hughlings Jackson, optic neuritis making its appearance at an early period, and white atrophy being the final result.

It must not be forgotten, however, that various cases have been recorded in which large tumours and extensive lesions of the brain have existed without any impairment of vision. According to Zehender, organic lesion of the cerebellum is insufficient to cause amaurosis.

A special form of amblyopia, passing sometimes into complete amaurosis, has been described recently by M. Dianoux under the title of anæsthesia of the optic nerves, characterised by more or less complete blindness without visible ophthalmoscopic lesion. It supervenes upon a central scotoma, first perceived after sleep, lasting for many months, and usually coexisting with cutaneous anæsthesia. Recovery may take place after appropriate treatment by potassium iodide, strychnia, and electricity, but it may also pass into white atrophy.

2. Crossed Amblyopia and Hemianopsia.—The phenomena of crossed amblyopia cannot be understood without a knowledge of the origin and course of the fibres entering into the composition of the optic nerves. On tracing the optic nerves backwards from the eye, they are seen to form a remarkable junction, named the chiasma, and to be continued beyond this, as the optic tracts, to the brain.

The course of the fibres of the optic tracts, on reaching the optic chiasma, has been the subject of much controversy, and is still open to further research. Some consider that there is here a complete decussation of the fibres of the optic tracts, others that there is mere juxtaposition without any decussation, whilst a third set of observers, who are constantly becoming more numerous, hold that there is a partial decussation. The chief arguments against this are, that occasionally the chiasma is absent and then complete decussation is observed, and, secondly, a median section of the chiasma has, in the hands both of Magendie and of Brown Séquard, been observed to produce total loss of vision. This result, however, does not appear to be constant. The evidence derived from the microscopic examination of the chiasma, from the effects of section in various parts of the optic nerve, chiasma, and tract, and lastly, from pathology, all point to the partial decussation, the non-decussating fibres chiefly supplying the outer side of the retina of the same side, and the decussating fibres, which are by far the most important, supplying the rest of the retina of the eye of the opposite side.

The view proposed by Charcot, and which has met with general acceptation, is that, admitting the fibres of the optic nerve to arise from one or more centres on each side of the cortex cerebri, some of these fibres course down through the optic tract of the same side, decussate in the chiasma, and are distributed to the inner, or nasal, side of the opposite eye. Other fibres arising from the same centre or centres, decussate in the corpora quadrigemina, and, descending in the opposite optic tract, pass to the outer or temporal side of the eye of the opposite side. Thus the whole of the fibres decussate, but some decussate in the chiasma and some in the corpora quadrigemina. Lesion of the cerebral centre of one side causes complete blindness of the opposite eye, because both sets of decussating fibres are destroyed. Lesion of the left optic tract would cause loss of the right half of each visual field, Lesion of the right optic tract would cause loss of the left half of each visual field. Lesion of the central portion of the chiasma causes temporal hemianopia; and lastly, lesion of the lateral portions of the chiasma would cause nasal hemiopia.

Neither the physiologist nor the pathologist can as yet localise an intracranial lesion occasioning blindness, and this is owing, not only to the wide connections of the optic nerves, but to the curious power of compensation that apparently exists between the opposite hemispheres; for it has been shown by Ferrier that sudden destruction of a very definite and limited portion of the brain, named the angular gyrus, on one side, causes complete blindness in the opposite eye; but if the opposite angular gyrus have remained intact, owing to this process or power of compensation, after a little while vision again returns in the previously blind eye, and, so far as can be ascertained, the animal sees as well with it as before. E. Munk, Crouineau, and others have found in their experiments that destruction of the angular gyrus is alone insufficient to cause blindness, though it may occasion amblyopia, but that destruction of the cortex of the whole occipital lobe invariably abolishes vision.

Amblyopia, proceeding to amaurosis, from cerebral disease, is usually accompanied with great dilatation of the pupil (mydriasis), but when resulting from spinal disease is associated with great contraction of the pupil (myosis).

In many of these cases other symptoms are present which point to the cerebrospinal origin of the disease. Amongst them are loss of tactile sensibility of one side of the body or of the face, hyperæsthesia, hemichorea, contraction of certain muscles, motor paralysis, and impairment of speech. The prominent eye-symptoms which have been fairly determined are, that there is amblyopia with contraction of the field of vision. Féré, who has put together the principal facts in regard to cerebral hemianopsia and amblyopia, distinguishes three groups: those which are post-apoplectic and transitory, those which are permanent, and those which are for the most part quite transient and accompany the affection known as 'la migraine ophthalmique.' The cases belonging to the first group result from the pressure produced by the effusion being propagated to, and acting upon, the optic tracts, which recover their function as soon as they have accommodated themselves to it, or as soon as absorption takes place. In the second group of cases the symptoms may be due to hæmorrhages or to the development of tumours, and the hemianopsia is most commonly associated with complete or incomplete motor hemiplegia; it is rare to meet with it in monoplegia; when, however, these are present, the face and upper limb are the parts chiefly affected. In cases of hemianopsia and motor hemiplegia aphasia may be present, and, in that case, the hemianopsia and hemiplegia are always on the right side. Hemichorea is occasionally present and is usually associated with hemianæsthesia. Hemianæsthesia not unfrequently occurs with hemianopsia, but the combination of hemianæsthesia, aphasia, and hemianopsia has only been observed in one case. The third group is characterised by various disturbances of vision, such as photopsia, often presenting the appearance of fortifications, and scotomata. There is also intense pain in the brow or temple, the attack culminating in nausea and vomiting. No very well-marked physical signs are present in this form, but the patients often suffer from dyspepsia, gout, rheumatism, or epilepsy. Between the attacks the vision may be normal.

Bellouard, who has closely studied the subject of hemianopsia, maintains that typical lateral hemianopsia is due to some lesion of the posterior extremity of the hemisphere near the posterior cornu of the third ventricle. Hemianopsia complicated with hemianæsthesia, with or without hemiplegia, is referable to participation of the direct sensory fibres of the pes pedunculi. Lastly, the co-existence of hemiplegia with hemianopsia renders it probable, he thinks, that the lesion is situated in the interior of the hemisphere, above and to the outer side of the optic radiation, that is to say, near the lenticular nucleus or external capsule. The lesion may, indeed, be in the paracentral lobe or centre for the movement of the limbs, but it is then distinct from that producing the hemianopsia.

3. Spinal Amblyopia. — (*a*) Tabetic Amblyopia—Amblyopia occurs as a symptom of progressive locomotor ataxy, and then constitutes the tabetic amblyopia of Charcot. The symptoms of this form of amblyopia, which is often syphilitic in its origin, are progressive deterioration of vision, the field of vision becoming gradually and concentrically limited. In some instances only one eye is affected, and complaint is made of a central scotoma, or dark spot, or several such spots, distributed over the field of vision. A greater or lesser degree of colour-blindness is usually present, red appearing of a very dark or almost black hue, and green appearing grey or dirty brown; whilst the secondary, or mixed, colours can no longer be distinguished. This defect of colour-vision does not necessarily proceed *pari passu* with the general failure of vision. Photopsiæ, or luminous phenomena of various kinds, are often observed. In the early stages of the disease, the fundus of the eye may appear almost natural. As the disease advances, however, the disk becomes gradually whiter, owing to atrophy of the capillaries. Microscopical examination shows that the axis-cylinders of the optic nerve fibres first undergo atrophy, and then the medullary substance, those nearest the arteria centralis retinæ, according to Leber, long retaining their normal characters. The connective tissue becomes greatly hypertrophied.

(*b*) Amblyopia is apt to occur in cases of grey degeneration of the posterior columns of the spinal cord; the disease in the nerves being of a similar nature, and affecting the whole, or a part only, of the optic nerves and tracts. It rarely occasions complete blindness.

The treatment to be recommended in this class of cases must vary, of course, with the special conditions of the case; but, speaking generally, it must be directed to the improvement of the general health. Fresh air, such exercise as can be taken, baths, friction of the skin, the administration of iron and strychnia; and silver nitrate, iodide of potassium, and perchloride of mercury may be prescribed, the effects of each being watched, and symptoms treated as they arise.

4. Toxic Amblyopia.—Amblyopia may be the effect of causes operating generally on the nervous system, the symptoms expressing themselves more strongly in the eyes, and these may now be briefly mentioned.

(*a*) *Amblyopia from Tobacco.*—This form of amblyopia has been made a subject of special study by Mr. Jonathan Hutchinson, who points out that since many men smoke, and, indeed, smoke inordinately, whilst few are affected in their powers of vision, it is probable that when tobacco produces amaurosis or amblyopia it does so in virtue of an idiosyncrasy, whilst the effects of the poison are undoubtedly augmented by the abuse of alcohol and other excesses. It occurs, as might be expected, almost exclusively in men, in some cases the actual quantity consumed not being large, though the effects are well-marked. In the great majority of instances both eyes are affected, and to nearly an equal degree, the vision becoming lowered to one-half of its normal sharpness. The progress of the disease is slow but continuous, though rarely proceeding to total blindness. It is usually accompanied by a state of general debility and defective tone of the nervous system. The patient complains of seeing everything as if in a fog, and the sight is impaired both for form and colour. The impairment affects chiefly the central part of the field, the defect being most perceived in bright lights.

The ophthalmoscopic symptoms in well-marked cases are that the disks are paler than natural, especially on the outer part, the surface swollen, and the margins blurred and indistinct, though without presenting the aspect characteristic of optic neuritis, peripapillary œdema being absent. The retinal vessels are smaller and less numerous than in the healthy eye.

In young persons, and in those in whom the attack has been induced by recent and excessive addiction to smoking, perfect recovery may, in general, be obtained by giving up the habit entirely; but in old smokers, in whom the progress of the affection has been steady and prolonged, and in whom, also, the atrophy of the disk is clearly perceptible, smaller improvement, or the arrest of the disease, is all that can be expected. Tonics, such as strychnia, iron, quinine, and sulphate of zinc, have appeared to be of service in aiding the nervous system to regain its tone.

(*b*) *Amblyopia from Alcohol.*—The symptoms here are similar to those observed in tobacco amblyopia. The patient complains of more or less sudden failure of vision, and this may be so great as to incapacitate him from all close work. The central part of the field is most affected. There is great loss of vision for colours, especially for green and red, which are described as appearing of a muddy tint. In the early stages there is probably some congestion of the optic disk, but it subsequently becomes pale, with woolly aspect, and finally white. In some cases of alcoholic amblyopia changes, perceptible under the microscope, have been observed. Thus, Uhthoff has given the results of section of the optic nerves in two alcoholists, who during life presented pallor of the temporal half of the optic papillæ. In one of these there was a central scotoma, or defect of vision, whilst the other presented at one time typical alcoholic amblyopia, which, however, had in great measure passed off before death. In both cases the anatomical lesions were nearly identical, differing only in their intensity. In both there was hypertrophy of the interstitial connective tissue, with considerable proliferation of nuclei, new formation of vessels, and atrophy of nerve-fibres. The degenerated nerve-fibres occupied the region between the central retinal vessels and the periphery of the optic nerve. In one case the chiasma and optic tracts were examined, and it was found that the degenerated fasciculi gradually left the peripheric region, and, in the optic foramen, formed a cylindrical mass near the centre of the optic nerves. In the chiasma itself a group of degenerated fibres could be distinguished in each half, which extended along the upper and inner part of the tractus. The treatment must consist in the absolute interdiction of alcohol in every form, the administration of tonics, change of air and scene, and general restorative measures. Remarkable cases of recovery may, under the altered conditions of life, be sometimes observed.

(*c*) *Saturnine Amblyopia.*—Amblyopia from the toxic influence of lead, or saturnine amblyopia, has been noticed by many writers. The symptoms are those of acute, subacute, or chronic lead-poisoning generally: headache, local paralysis, and blue line on the gums, with gradual deterioration of vision.

The ophthalmoscopic signs are not strongly marked, but there is probably a stage of hyperæmia of the disk, if not of actual neuritis, and this is succeeded by a period during which the disk becomes pale, ill-defined at the margin, and ultimately white.

(*d*) *Quinine Amblyopia.*—Besides alcohol, tobacco, and lead, some other drugs have been known to cause amblyopia; thus cases are reported where it has resulted from excessive doses of quinine, the amblyopia amounting, in some instances, to almost complete amaurosis. It usually passes off as soon as the use of the remedy is discontinued, though it may, in some instances, leave persistent dulness of vision and contraction of the field behind it. The ophthalmoscopic symptoms are few and slight, consisting chiefly of pallor of the disk, with some diminution in the size and number of the retinal vessels. Belladonna again, with several other solanaceous plants, has been known to produce, when taken in poisonous doses, temporary amblyopia.

(*e*) *Amblyopia from Malarial Poisoning.*—Occasional or exceptional conditions of amblyopia have been noticed in intermittent fever. Peounow, for example, reports four cases of slight diminution of the sharpness of vision during the attack, together with impairment in the perception of colours, or even a chromatic scotoma in the centre of the field of vision, which disappeared quickly under the influence of quinine.

In consequence of the general failure of power in the constitution and bodily powers in diabetes, it is not surprising that failure of accommodation should occur; and Trousseau has drawn attention to this as one of the most common as well as one of the most remarkable of the symptoms of saccharine diabetes. But, apart from this, there is probably a form of amblyopia in diabetes which owes its origin to changes in the optic nerve, and there is still another in which the amblyopia is essentially due to retinal hæmorrhages.

5. Diabetic Amblyopia.—In diabetic as in tobacco amblyopia, there is sometimes an area of red blindness near the centre of the field of vision.

But few observations have been made upon the microscopical aspect of the optic nerve in cases of diabetic amblyopia. Drs. Edmunds and Lawford, however, had the opportunity of making sections of the optic nerve in a case of diabetic amblyopia, in which during life the appearances presented by the fundus of both eyes were normal. It should be stated that the patient had at one time indulged immoderately in the use of tobacco. No macroscopic changes were perceptible in the nerve, but, under the microscope, marked changes were found in a group of the nerve-bundles throughout the whole length of the orbital part of the nerve, the trabeculæ, and the walls of the nutrient vessels were found to be greatly thickened, the fasciculi of nerve-fibres seemed to have the fibres in them destroyed, their place being taken by an irregularly granular structure, containing a large number of nuclei which stained with colouring agents.

6. Renal Disease. — Impairment of vision is sometimes the first symptom that leads to the discovery of albuminuria, and it is a very common concomitant of the later stages of that affection. *See* Optic Nerve; Retina, Affections of the.

7. Amblyopia in Pregnancy.—Amblyopia not unfrequently occurs in the course of pregnancy, and it may range through all degrees, from slight impairment to almost complete loss of vision. In the slighter cases the defective vision is probably due to loss of accommodation from mere weakness and exhaustion of the nervous system in general, and of the ciliary muscle in particular, and is consequently most marked in those who are the subjects of hypermetropia, though this may previously have passed unnoticed. In the more severe forms, well-marked ophthalmoscopic symptoms may exist, which bear a close resemblance to those of albuminuric retinitis, the optic disk presenting the aspect of optic neuritis, its margins being ill-defined, its surface swollen and woolly, the veins full and dark, tortuous and varicose, the arteries small, and seen with difficulty. Here and there large areas of effusion of whitish colour are to be seen on the surface of the retina, with irregular patches of hæmorrhage. These conditions are commonly associated with the presence of albumen in the urine, and it is highly probable that they proceed from pressure exerted by the uterus on the renal vessels, and especially on the renal veins, since the affection usually commences about the seventh month of pregnancy, and the symptoms continue to increase in intensity to the full term. After delivery is effected, they gradually decline, and in some instances perfect recovery may take place, though in others the vision of one or both eyes may be permanently impaired, and, under the ophthalmoscope, more or less advanced white atrophy, with discoloured areas, indicating the former presence of retino-choroiditis, may readily be seen.

The treatment of this form of amblyopia should, unquestionably, be the induction of premature labour, which probably acts by relieving the renal vessels from the pressure to which they have been subjected, and by effecting a restoration of the normal conditions of circulation in the capillaries of the kidney. The writer has seen several cases where the adoption of this plan of treatment has lead to immediate, great, and persistent improvement in the vision of eyes which appeared to be almost hopelessly blind, in which, indeed, there was little more than quantitative perception of light. On the other hand, he has known cases in which, when pregnancy was allowed to progress to its natural termination, the visual troubles were only premonitory of death by convulsions, or to blindness of an incurable nature.

8. Amblyopia from Cardiac Disease.—An intermittent form has been described by Nettleship, associated with valvular disease of the heart, the characteristic symptoms of which are, that the impairment of vision supervenes suddenly, lasts for a short time only, varying from a minute or two to an hour or more, and quickly disappears. The attack is not limited to one eye, but most frequently affects only one, and not always the same. It is probably connected with vascular constriction of an irregularly periodic character, and primarily dependent on some lesion or disturbance of the nervous system. The treatment should be directed to the heart, and to improvement in the general health of the patient.

9. Hysterical Amblyopia. — Impairment of vision not unfrequently occurs in hysteria. In hemianæsthetic hysteria, amblyopia, with concentric contraction of the field of vision, is apt to occur on the same side as that on which the anæsthesia exists. In the cases of hysterical amblyopia, examined by Landolt at the Salpêtrière, it was found that there was concentric contraction of the visual field for white light and for colours. The cause of this condition is not known, but it may, with much probability, be referred to alterations in the calibre of the blood-vessels leading to irregular, imperfect, or perverted nutrition of particular regions. Ophthalmoscopic examination, in some instances, demonstrates the presence of optic neuritis.

Diagnosis.—To determine the nature and degree of amblyopia, where no reason for suspecting simulation exists (*see* Vision, Feigned Disorders of), a methodical examination of the eyes should be undertaken, and special attention should be paid to the sharpness of vision for form and colour, the field of vision, the physical condition of the eye, including the appearances seen with the naked eye and with the aid of lenses, by direct and oblique illumination, the refraction of the eye, and, lastly, the appearances presented on examination with the ophthalmoscope. *See* also Visual Acuity; Ophthalmoscopy; Perimetry.

Henry Power.

AMBULANCE.—The term ambulance is so elastic in its acceptation, that it is difficult to know how to limit its scope. In the widest sense it signifies a movable, in contradistinction to a fixed or stationary, means of affording relief. The patients are sought for by the doctor and his assistants, instead of the patient coming to the doctor. First aid to the injured cannot be dealt with in this short article, but only the means of carrying or transporting the sick or injured.

In all times such means have been used, but the modern stretcher has supplanted the historic buckler, the waggon the war chariot, the litter and cacolet the haphazard throwing across a horse or camel's back.

To follow the different plans now in use in peace and war, it will be profitable to divide the means employed into carriage by hand, by stretcher, by waggon, by cacolet, by litter, and by railway carriage.

I. Carriage by Hand.—1. *When only one bearer is available.*—*a.* If the patient can stand, the bearer places himself at the uninjured side, say the right. The bearer then places the patient's right arm around his (the bearer's) neck and grasps the wrist with his right hand. The bearer's left hand now grasps the patient's left hip. By this manœuvre the patient's weight is thrown on to the bearer, who can thus help him along or even carry him.

b. By the fireman's lift. Standing in front, the bearer seizes the patient's right wrist in his left hand, then bending down until his right shoulder is below the patient's right hip-joint, he throws the patient across his shoulders and back, and grasps the legs with his right arm.

2. *When two bearers are available.*—*a.* Two-handed seat. The bearers face each other, the right-hand bearer presents his right hand for the left bearer to grasp with his left hand, or *vice versâ*; the free hand of either bearer then grasps the clothing over the hip, loin, or shoulder of the other, to form a back or support for the patient. The clasped hands are brought firmly together, and on these the patient sits; the patient's arms should encircle the bearers' necks.

b. Three-handed seat with support for the back. The bearers face each other; the right-hand bearer grasps his own left forearm; the left-hand bearer with his left hand grasps the right bearer's right forearm, who with his free hand grasps the left bearer's right forearm. A triangular seat is thus formed. The left bearer's free arm is placed on the right bearer's shoulder, to form a support for the back.

c. Four-handed seat. The bearers face each other; each grasps his own left forearm, and approaching hands, each man seizes the right forearm of the other with the disengaged hand, a sedan-chair being thus formed. By any one of these methods patients may be carried some distance, or placed on the tail seat of a waggon or on a cacolet. If the patient cannot stand, others might lift him on to the seats thus formed.

II. Carriage by Stretcher.—Stretchers consist essentially of a couple of poles with canvas or other material stretched between them, and must be long enough and broad enough to carry a patient.

a. Stretchers for use in hospitals. The best form is a piece of canvas 6 feet 6 inches long, 1 foot 10 inches wide, with a couple of pole-sheaths at the sides. This piece of canvas can be passed below a patient as is an undersheet, and the poles, 8 feet long, slipped into the sheaths when it is wanted to move the patient, say from the bed to the operating table, or *vice versâ.* A couple of iron traverses to keep the poles apart can be adjusted after the poles are in place.

b. Stretchers used in the field or in the streets must have supports in the form of legs or wheels. The army pattern stretcher has wooden wheels, whereby it can be rolled into an ambulance waggon. The canvas is 6 feet long, 1 foot 11 inches wide, the poles are 7 feet 9½ inches long, and the traverses made to bend in the centre with an easily opened and easily closed joint.

Methods of placing a patient on a stretcher:—

1. Four bearers are assigned to each stretcher according to the army regulations. The stretcher is placed parallel with the patient, close to, say, his right side. Three bearers take post on the left side of the patient, one opposite the shoulder, a second opposite the hip, and a third opposite the knee. The fourth bearer places himself on the opposite side of the stretcher to the patient. The three first-named now raise the patient by placing their hands below the patient, whilst the fourth bearer pushes the stretcher beneath the patient when he is raised, and then helps to gently lower him on the canvas.

2. Another method, that practised by the St. John's Ambulance Association, requires three bearers only. The stretcher is placed in line with the patient, either at his head or feet; one bearer takes stand on either side of the patient opposite the middle of his body, and each passes his hands beneath the patient's shoulders and hips until the fingers of the bearers meet, when they grasp each other's hands; the third bearer passes his hands beneath the legs, and all rising together advance by a side step over the stretcher.

3. A still better method is as follows. Place the stretcher in a line with the patient's body at the head or feet. Two bearers now stride across the patient, one opposite the body, the other opposite the knees. Both, bending down and seizing the patient, raise him a sufficient height from the ground to allow the third bearer to push the stretcher between their legs, i.e. beneath the patient.

4. When two bearers only are available, the stretcher is laid in a line with the patient's body at the head or feet. The two bearers then stride across the patient, and raising him a sufficient distance, straddle forwards with their burden until over the stretcher.

To *carry* a stretcher two bearers are sufficient, but a third or fourth are useful to look after the patient and to relieve the others in carrying. A patient should always be carried feet first, except when going up a steep hill. If the patient is suffering from a broken thigh, he ought to be carried head first even coming down hill, and feet first going up, to prevent jostling of the fragments one on another. The bearers walk in broken step to prevent the stretcher swinging. The steps taken must be short—twenty inches; the knees are to be kept bent, and the feet lifted high off the ground. Leather or canvas belts over the bearers' shoulders and around the handles of the poles, are efficient aids in carrying. In going up a hill the shorter bearer, if there is a difference in height, should go in front, and *vice versâ* coming down. On going up or down a slope, the aim is to keep the patient as nearly as possible on a level, and this may be done to some extent by either bearer raising or lowering his end of the stretcher as occasion arises.

Improvised Stretchers.—1. A blanket and broom-handles.—The blanket, rug, horse-cloth, plaid, &c., is laid flat on the floor or ground, and a couple of broom-handles, pitch-forks, goal poles, rifles, &c., wrapped up in it one from either side until within a foot of the centre of the blanket; the patient is then laid thereon, and four bearers are at each corner to grasp the poles where they are wrapped in the blanket with one or both hands. This will do for short distance carriage, but for longer distances, say half a mile, use the following.

2. Secure a stout loop at the four corners of a blanket, then double it over so that the two loops at either end are brought together, then slip one pole through the loops on one side, and another within the doubling of the blanket on the other side.

3. A ship's hammock may be arranged to be carried on a single pole, and borne on the shoulders, or two poles may be utilised by a little management.

4. A couple of poles may be kept apart by cross poles tied or nailed at either end, and then the bottom can be made up of straw, ropes, belts, knapsacks, &c.

5. Coats are utilised thus:—Two long poles or four rifles are required, the pairs of rifles being lashed together at the muzzle-ends; the sleeves of the coat or coats are then turned outside-in. The coat is laid on the ground, the back of the coat next the ground; the two coats being in line, the rifles or poles are pushed through the sleeves, and the coats buttoned down the front in the usual way.

III. CARRIAGE BY WAGGON.—An ambulance waggon is a four-wheeled vehicle, set on easy springs and drawn by two horses. It is capable of accommodating two patients lying on stretchers in the body of the vehicle, three more sitting on the front seat, and three, two patients and an attendant on the hind seat—eight in all. Over all is a canvas covering, and on the waggon are fitted a small water-tank and various boxes, ready to convey stores on an emergency. The rifles of the men lying down are placed beneath their stretchers, and their kits in the box beneath the drivers' seat. Waggon-stretchers are now essentially the same as the field stretchers, both being provided with wheels. To place the stretchers in the waggon the bearers halt a few paces off the tail of the waggon. The four bearers then seize the poles at the sides, as with the blanket-stretcher, and advance with a side step until the front wheels rest on the floor of the waggon. Then the stretcher is gently rolled onwards along the waggon floor.

On the hind seat are placed those patients who are unable to walk; on the front seat only such patients as are able to walk, since it is necessary to go up a ladder to reach it.

IV. CACOLETS are folding chairs, hooked one on each side of a pack saddle, carried by a mule or pony. The patients are necessarily in the sitting posture, their faces towards the animal's head. Patients suffering from fractures or severe injuries to the lower extremities, or who are very weak, must not be put on a cacolet. The cacolet is loaded by two bearers carrying the patient by a hand-seat, back first, towards the chair, on to which he is raised. The feet are placed on the foot-board and the waist-straps buckled to keep the patient on.

V. A LITTER is a light iron framework couch, capable of being placed on the side of a mule or pony for the purpose of transporting sick or wounded. A mule can carry two litters. As the mule stands higher in front than behind, the patient lies with his head towards the animal's head. Foot-rails and side-rails are placed to prevent the patient slipping backwards, or rolling over the edge. To load a litter it is laid on the ground, the patient laid thereon by one or other of the methods of placing a patient on a stretcher. The litter is then raised to the animal's sides, and the apparatus hooked, buckled, and belted thereon. Litters and cacolets can be folded into very small bulk when not in use.

VI. CARRIAGE BY RAILWAY is effected in:—

1. Invalid carriages. These are simply travelling hospitals, in which the patients are placed on stretchers in bunks instead of on beds. They have all lavatory conveniences and medical and surgical necessaries. Each carriage can accommodate eight patients in two tiers on either side.

2. Second-class carriage seats, being cushioned but not partitioned, are available for a couple of stretchers. Two cross-pieces of wood are laid from seat to seat, each about a foot from the door. The stretcher has to be slightly tilted to get it through the door (1 foot 10 inches wide). A couple of stretchers can be laid along the seats, one on either side, and space left between for the attendant.

3. Goods-waggons and cattle-trucks can be utilised, but each stretcher requires four steel springs on which the handles of the stretcher can be placed. Three stretchers only can be placed on each waggon. The stretchers should not touch the sides of the waggon.

Surgical assistance in the field is regulated thus:—

I. Position of the 'first help station.'—This is immediately in rear of the fighting line, and moves with the combatants. Here only first dressings are applied, when the patient is carried on a stretcher to—

II. The second help or 'collecting station,' 1,000 yards in rear, or just out of rifle range. Here the wounded are placed in waggons, and the bearers are left free to return. Only first aid or hasty re-adjustment is to be here applied, as the patient is hurried off to—

III. The third help, or 'dressing station.' This is again 1,000 yards behind the collecting station, or out of the range of artillery fire. Here the wounded are sorted, ticketed, examined as regards the nature of their injuries, and such operations as are evidently imperative are to be done, but this is not the operating station. From hence the wounded are sent to—

IV. The fourth help, or 'field hospital station.' This should be about four miles to the rear of the combatants, and here the wounded are treated, amputations performed, &c. as is usual in an ordinary civil hospital. Those who can be are sent as soon as possible to—

V. The 'base hospital,' at the seaside, it may be, or in some town the base of the military operations. JAMES CANTLIE.

AMETROPIA.—Any optical condition of the eye, in which, accommodation being suspended, entering parallel rays are not accurately focussed on the retina. The term includes MYOPIA, HYPERMETROPIA, and ASTIGMATISM. *See* REFRACTION, Errors of.

AMPUTATIONS. — GENERAL CONSIDERATIONS. — Amputations, having for their object the removal of a limb or portion of it, are performed, as a rule, in cases of severe external injury, gangrene, morbid growths, many forms of bone and joint disease, intractable ulcers, malformation, aneurism, &c. Re-amputations are recognised and performed on account of certain affections of the stump, such as the conical or 'sugar loaf' stump; necrosis, neuromata, persistent pain, large adventitious bursæ, aneurismal dilatation of vessels, &c. *See* STUMPS, Affections of.

Amputations have been classified with special reference—(1) to the form of flap; (2) the situation where the bone is divided; (3) in traumatic cases, the time after the receipt of the injury that the operation is undertaken; and (4) there are *partial* and *complete* amputations, as of the foot. Then we speak of amputations by *circular* or *flap* methods, and of amputations in the *continuity* or *contiguity*, i.e. where the division of the tissues includes that of the bone at a point more or less removed from its extremity, or passes through an articulation. Another classification (Alcock's) is into *primary*, *intermediary*, and *secondary*. In the primary, the operation is performed immediately after the receipt of the injury and before there is evidence of any febrile disturbance. Secondary amputations are those undertaken at a time more or less remote from the date of the injury, and when suppuration as well as other unfavourable sequelæ, such as bone or joint disease, have supervened. Intermediary amputations are those undertaken subsequent to febrile excitement, but before the occurrence of the other results just mentioned.

In the history of amputation three distinct eras are recognised. In the first of these, operating surgeons made no attempt to form any kind of flaps, the limbs being removed at times by the knife; the 'Cauterium cultellare' (Hildanus); the chisel and mallet (Scultetus, Heister); the pincers (Guillemeau); and the guillotine (Père Botallus). The main object surgeons had in view was, apparently, not so much to obtain a shapely and useful stump as to take precautions that the patient did not succumb to hæmorrhage during the operation. To prevent death from this cause many and various were the devices had recourse to; such as division of the tissues with red-hot irons, plunging the stump into boiling pitch or oil, and the application of variously shaped cautery-irons to the bleeding vessels. It is not surprising, therefore, to learn, as we do, from the writings of Thomas Gale (1563), of the dread people had of this method of checking hæmorrhage by the 'terrible fire, by means whereof many people perished,' and these operations were not unnaturally stigmatised as the 'opprobria of surgery.'

In the second era, commencing towards the end of the sixteenth century, the circular method was advocated and practised. There is evidence that the merits of it were appreciated in 1560 by Ambrose Paré, to whom we are indebted for the introduction of the ligature as a means of arresting hæmorrhage. Although the circular method is mentioned in the writings of Celsus, as is also the ligature, it was not until 1560 that the ligature obtained recognition. The introduction of the ligature, and the invention, a century later, of the tourniquet by Morel (1674), which instrument was advocated by Petit (1708), were doubtless main factors in enabling surgeons to devise better methods of amputating than those previously adopted.

Several modes of performing a 'circular' amputation are recognised—for example, those of Louis, Petit, Mynors, Alanson, O'Halloran, Bell, and others. In the first of these the skin was retracted and two bandages were applied—one above and the other below the line of incision, in order to steady the soft parts, which were divided by a circular incision down to the bone. Then, in order to allow the superficial muscles to retract, the operator removed the upper bandage, and the deeper muscles were divided by a second incision, and the bone was divided on a line with the retracted superficial layer at that point. This Malgaigne states is 'very nearly the method described by Celsus, as Louis himself allows.' The practice of dividing the skin down to the fascia in the first instance, at a point below where the bone is to be divided, retracting the skin and subsequently dividing the muscular tissues down to the bone on a level with the retracted skin, was introduced by J. L. Petit (1708). Mynors, of Birmingham, went a step farther, and dissected back and reflected the skin to a point on a level with the bone-section. These methods were improved on by Alanson (1782), who introduced oblique division of the muscles, the wound eventually resembling 'a conical cavity, the apex of which is the extremity of the bone.' The parts thus divided he states are 'obviously the best calculated to prevent a sugar-loaf stump.'

The 'triple incision' of B. Bell, of Edinburgh, consisted in the primary division of skin and fascia; secondly, the muscles; and finally, the bone. Mr. Hey, of Leeds, and Desault, have also advocated amputations by 'triple' incision. Mr. Hey advised division of the posterior muscles at a somewhat lower level than the anterior, having regard to the greater tendency of the former to retract and contract.

Other modifications of the 'circular' method have also been proposed, such as that in which two semilunar incisions (Syme and Liston) are made, one on the anterior and the other on the posterior aspect of the limb, the alleged advantages of which are the greater facility afforded for the reflection backwards of the flaps. Another modification is that of Lenoir, having also for its object the facilitating a dissection backwards of the integumental flaps. Having made a circular incision, not passing deeper than the fascia, an inch and a half below where the bone is to be divided, a vertical incision from this point is made, and the two angular flaps can then be easily dissected back, the incision assuming a somewhat oval form. The method appears mainly applicable to amputations of the leg below the place of election, and to the lower third of the forearm.

The credit of priority in the introduction of flap amputations is due to Mr. James Young of Plymouth (1678), who, in amputations of the leg, recommended 'a flap of the membranous flesh covering the muscles of the calf.' Subsequently Verduin recommended a similar flap, but, instead of cutting it from below upwards, he made it by transfixion. Many have been the forms, varieties, and modifications of the amputation originally suggested by Mr. Young: single and double flaps, unilateral, bilateral, antero-posterior, oval, and rectangular. In thigh amputations, O'Halloran first recommended the long anterior and short posterior flap. This method, with slight modifications, has been practised and advocated by B. Bell, Liston, Sédillot, Fergusson, and Spence.

Among the more recent developments of flap amputation are those of Carden and Teale, together with the operation at the knee of Gritti, and the modification of it to which the writer has given the name of supra-condyloid. The advantages of the single flap method are thus epitomised by Carden:—'The facility afforded for amputating either through the knee or through any part of the lower end of the femur, thus proportionately avoiding the shock of higher amputation, and the risks of exfoliation, pyæmia, &c., attendant on sawing through the cylinder of the bone; the simplicity of the whole proceeding, and small extent of the wound; the favourable position of the flap for dressing, and for the escape of discharge; painlessness and quietude of the stump, the principal nerves being divided high up and drawn out of reach of pressure or exposure; the fitness of the stump to stand and walk upon, the bearing being broad, and the skin employed being accustomed to bear the weight of the body in kneeling; the cicatrix being drawn clear of the point of the bone, out of the reach of pressure.'

Notwithstanding these alleged advantages, and the fact that the operation was approved of by Professor Syme, the writer has known the 'surgical calamity' of sloughing of the flap to occur after this operation, and that in more than one case. This is most likely to happen in weakly, delicate, anæmic subjects, and the operation therefore, in such cases, should not be lightly undertaken. When there is reason to apprehend this accident supervening, the flap should be made wider than is recommended by Carden. Thus the risk of sloughing is diminished. It is also to a great extent obviated by the modifications of Sir J. Lister and Professor Spence, in which procedures the anterior flap consists, not merely of integument, but also of muscular tissue. The chances of the accident occurring are, however, more effectually avoided in the percondyloid amputation of Gritti, or in the supra-condyloid modification of it, in both of which operations the patella is included in the anterior flap.

The flap amputation which best fulfils all the requirements needed is the rectangular method of the late Mr. Teale, the special advantages of which are apparent not merely in thigh amputations, but also in those of the leg, fingers, arm, and forearm. These advantages are: the remote danger of sloughing of the flaps, the abundant covering for the bone and consequent diminished risk of the formation of a conical stump; the cicatrix not being on the face of the stump, but placed posteriorly and above it; the facilities for the escape of fluids from the wound, rendering drainage almost unnecessary; the principal nerves and vessels, being in the posterior flap, are not liable to the injurious effects of pressure; and the main vessels being in the posterior flap, the operator can find and secure them with the minimum amount of disturbance to the wound. It has also been claimed for this operation that the stumps can bear the weight of the body better than after the ordinary circular or flap operations. This opinion, however, though the probabilities of its accuracy are great, is one which the writer is not disposed to endorse.

Two main objections have been made to Teale's operation: one is the length of time that its performance occupies, and the other that the great length of the anterior flap requires a high division of the bone. Although previously to the discovery of anæsthetics (1846), the objection to a surgical operation because of the length of time it occupied would not have been groundless, that objection cannot now be urged. Besides the advantages to the patient obtained by anæsthetics, viz. the prevention of suffering, diminution of shock, and subsequent oblivion of the details of the operation, must be added those enjoyed by the operator—namely, power to act with deliberation, calmness, and freedom from anxiety, care, and hurry; and these advantages are as great to the operator as those already mentioned are to the patient.

The second objection to Teale's amputation is based on the alleged necessity for a higher bone division than in other amputations. There can be little doubt that by following accurately Mr. Teale's directions, in very many instances, both of leg and thigh amputations, a low division of the osseous structures would be impracticable. This is not of so much consequence in amputations of the leg, since the lower third of that limb is not, as a rule, a situation selected by surgeons for the performance of amputation; but in the thigh, the case is different. Here it is all-important to save as much as possible of the bone, not only with the view of subsequent adaptation of mechanical appliances, but also because in thigh amputations, as Dieffenbach has expressed it, 'the danger increases inch by inch.' To avoid a high section of bone, two modifications of Teale's amputation have been proposed by Sir J. Lister and Mr. Wharton. Having regard to the forward position of the bone among the muscles, the posterior surface of it being anterior to the longitudinal axis of the limb, Sir J. Lister makes the following proposal:—An anterior flap, two-thirds of the diameter of the limb, 'after being marked out by carrying the knife through the skin and fat, should be raised so as to contain a good deal of muscle,' and a posterior one, rather more than half its length, of rounded shape, is then made, the integuments of which should be dissected up before the posterior muscles are divided, 'in this way preventing the effects of undue contraction.'

The high division of bone, and extensive division of muscular tissue—the two alleged defects in the rectangular method—are also got rid of by the modification proposed by Mr. Wharton:—'Let the measurements for Teale's amputation be accurately taken and mapped out; but, instead of dividing the bone at the site directed by him, let it be sawn at the situation corresponding to the inferior termination of his posterior flap, and let the superior boundary of his anterior flap be limited by the same plane. The saving of bone thus effected will be considerable, and therefore tend directly to diminish the mortality of thigh amputations. According to this method the anterior flap will be shorter by a fourth than Teale's, and there will be no posterior flap.'

But against this modification it is objected that the cicatrix is too near the surface of the stump; that there is tension of the soft parts on the face of the stump; that the covering is insufficient; that, owing to retraction of the tissues, the posterior surface of the bone projects, and is denuded of soft tissues; that there is a liability of the cicatrix becoming adherent to the immediately subjacent bone; and that the risk of pyæmia is increased. The writer's experience would, however, undoubtedly tend to establish the groundlessness of most of these objections; but, though willing to acknowledge and bear testimony to the excellence of the results obtained by Wharton's modification, he fails to recognise the alleged defects of the rectangular method as originally recommended by Mr. Teale.

For the circular and flap methods, special advantages are claimed. Among those said to belong to the circular method is diminution of shock, the area of the wound being less in extent than in 'flap' operations. It has also been claimed for circular amputations that, owing to the vessels being divided at right angles to their continuity, the risk of secondary hæmorrhage is diminished, no fenestrated openings in them being possible, a result which may occur in flap amputations, especially when done by transfixion. Again, it is claimed that the risks of phlebitic inflammation are diminished, the wounds in them being less in extent than when divided obliquely, as in flap amputations. And lastly, it is alleged that the mortality is less; but the foregoing advantages appear to be highly problematical. On the other hand the advocates for flap amputations claim greater shapeliness of stump, possibility of operating with greater speed, diminished risk of conical stumps resulting, better covering for the bone, and the stumps being better adapted for the subsequent adjustment of prothetic mechanical appliances.

Previously to the introduction of anæsthetics and Listerian antiseptic practice, the main objections urged against flap amputations may not have been altogether groundless, but that they are so now appears to be beyond question, and there is moreover a general consensus of opinion among operating surgeons that, in the majority of cases, 'flap' amputations are to be preferred, as giving the most satisfactory results.

The Performance of an Amputation.—Before performing an amputation the precautionary measures to be adopted may be considered. The day previous to the operation the patient's bowels should, if confined, be acted on either by an enema or by some mild but efficient aperient. On the morning of the operation the food given should be small in quantity, and of the lightest and most easily digested quality. In some of the more important amputations, such as those of the thigh, at the hip, knee, or shoulder joints, the writer is in the habit of giving the patient an antiseptic (eucalyptol) bath, it being desirable to render the part to be operated on as completely aseptic as possible by diligent washing, and getting rid of all superfluous epidermic accretions by rubbing with soap and pumice. The application of turpentine or ether to the part, to get rid of greasy matters on the skin, is strongly to be commended, and then swathing the limb in moistened carbolised or eucalyptol gauze. The next point is the prevention of hæmorrhage. The tourniquet of Petit and the various modifications of that instrument have been so entirely superseded by the introduction and employment of the so-called Bloodless Method of Esmarch, that any detailed description of the former instruments and their mode of application is unnecessary. But Esmarch's method is not applicable in all cases—for example, in cases of gangrene, or when there is any purulent deposit or infiltration. In such cases it would be preferable to adopt the plan of elevation of the limb for some time previous to the amputation. There are, it has been stated, certain alleged defects connected with Esmarch's method. These are the pain it causes and the liability to produce sloughing and paralysis, especially the latter, when applied to the arm. The writer, after an experience of ten years' constant use of this 'bloodless' method, can bear testimony to having never on any occasion seen those accidents which, in the practice of others, are said to have occurred. On the other hand, he is not prepared to endorse the views of M. Marduel, who in his exhaustive paper, states that the artificial production of a local anæmia not only is unattended with the risks already alluded to, but promotes rapidity of union and diminishes the risk of traumatic fever.

As regards paralysis of the arm following the application of the elastic tubing or tourniquet, Von Langenbeck suggests that for the tubing a flat elastic bandage be substituted. The effect of this would be to diffuse the pressure, and in that way diminish the chances of any mishap occurring from an undue amount of pressure at one point where there was the minimum amount of covering and protection to the nerves. With the same object Sir J. Lister advocates preliminary elevation of the limb, or the 'method of position,' as being one in which an equal amount of local anæmia is produced, with, at the same time, an immunity from the danger of other accidents.

In certain amputations, such as those at the hip and shoulder-joints, other means for the prevention of hæmorrhage than these are employed: in hip amputations, the abdominal clamp of Sir J. Lister and Mr. Davy's rectal lever; and in disarticulations at the shoulder, the method of compression of the subclavian artery on the first rib. These, however, will be better discussed in connection with a detailed description of those procedures. The various forms of forceps for seizing the vessels for the purpose of applying a ligature are the so-called 'bull-dog,' Nunneley's, Liston's, and Von Langenbeck's catch-forceps, and, lastly, Kœberle's, which is, in the writer's opinion, superior to all others hitherto devised. In cases where the vessel to be secured retracts greatly, it often happens that the tenaculum will succeed when the above-mentioned instruments fail. For example, in amputations of the leg, the interosseous vessels are especially likely to give trouble from this cause. In such a case the tenaculum will be found most useful. With the object of preventing this difficulty arising Sir G. Porter makes a practical suggestion—namely, that the inter-osseous structures should be divided with the catlin at a situation a little below the point where the bones are divided.

In what may be termed the pre-antiseptic era surgeons had, and with reason, a great dread of phlebitis being induced by the ligature of veins, and the practice, consequently, was universally condemned. The introduction, however, of Listerian antiseptic practice has effected a complete and signal revolution. The writer is unable to recall a single instance in which the ligature of a large or small vein—efficient antiseptic precautions being taken—was attended with any secondary trouble whatever. The sailor's 'reef-knot' is the best to employ, and both ends should then be cut short. For the larger vessels chromicised catgut of medium thickness is to be preferred, as its absorption takes a longer time, but in vessels of smaller calibre ordinary carbolised catgut may be used.

The instruments—amputation knives and scalpels—for the division of the soft structures may here be alluded to. The first-named instruments may be divided into two classes—those rounded at the ends and with strong thick straight backs. These are, as a rule, used in 'circular' amputations. The other class consists of long comparatively slender blades, and pointed at the extremity. These 'catlin' knives, as they are usually called, are employed generally in transfixion flap methods. In certain amputations, such as Carden's, Teale's, and the supra-condyloid method, the use of a full-sized scalpel for making the anterior flap may be employed conveniently, the ordinary amputation-knife being used for making the posterior flaps. Some surgeons prefer, in order to add a certain amount of brilliancy to the operation and save a few unimportant seconds, using one instrument throughout; but there is no special advantage to be gained by doing so. In forming a skin flap, as in Carden's operation, care should be taken not to keep the cutting edge of the knife towards the skin, as in an anatomical dissection. The danger of doing so is the liability of the flap to slough, arising from the nutrient vessels in the subcutaneous tissues being divided during the operation. Another important practical point to bear in mind is the necessity for holding the knife so that the edges of the skin shall not be bevelled, but divided perpendicularly. The dangers of sloughing will in this way be also diminished. On reaching the bone care should be taken to divide the periosteum with the knife, and not, as is so often done, with the saw. Neglect of this is apt to be followed by periostitis from the tearing or laceration of the membrane, an accident which in its turn is followed by necrosis at the extremity of the divided bone.

According to Von Langenbeck, Trélat, and others, the formation of periosteal flaps to cover the cut surface of the bone is believed to be attended with advantages. These are held to be that the periosteal curtain covering the medullary canal acts as a barrier against the introduction of septic agencies, and diminishes, consequently, the chances of the occurrence of osteo-myelitis. It can be done either by making a somewhat quadrilateral-shaped flap and letting it fall over the cut surface of the bone, or by the method of M. Trélat, which is to detach the membrane all round the bone for fully an inch below the point where the bone has to be divided, making thus a sleeve-shaped flap. The writer fails to recognise the advantages of either method.

The division of the bone should be made by a broad-bladed saw with finely-set teeth. The advantage of the broad blade is that it is much easier to make a plane, even section, and, in commencing it, by placing the left thumb-nail against the side of the blade, the operator can steady the instrument and prevent it getting out of the groove it makes in the first instance, in a manner hardly possible when any narrow-bladed instrument is employed. The operator should commence by laying the heel of the instrument on the bone, drawing it towards him to its full length, and complete the division, taking care to avoid too rapid an action of the instrument, as from the friction an amount of heat is generated which, it is alleged, may injuriously affect the bone. If the edges of the bone be sharp, and likely to exercise an injurious effect on the flap, bone-forceps can be employed to round them, and thus diminish the chances of ulceration from pressure.

All bleeding vessels having been secured by carbolised catgut, or other equally aseptic sutures, the wound should then be dressed. *See* ANTISEPTIC SURGERY. The writer, notwithstanding what has been said and written to the contrary, ventures to express his conviction and belief that rendering the atmosphere in which the operation is performed thoroughly aseptic, whether it be done by carbolised spray or other means, is of the first importance.

Another point in connection with the treatment of an amputation wound, which the writer would emphasize is the desirability of a free application of a zinc chloride solution (30 to 40 grs. ad aquæ f℥j.) to the wound, drainage, and taking care not to close the wound until all oozing has ceased; the use of deep, as well as superficial, sutures, and externally the dressings of gauze treated with carbolic acid, eucalyptol, or corrosive sublimate; or, again, wood wool or turf, similarly treated, the latter of which dressings, so much employed of late in Germany, give the best results.

In the performance of an amputation, the operator should have at least four assistants: one to anæsthetize the patient; a second to command the hæmorrhage by tourniquet, digital pressure, or elastic bandage; a third to retract the flaps and ligature vessels; and a fourth to hand the instruments and other appliances.

The principles which should guide the surgeon in the treatment of amputations, and of all wounds, have been clearly and forcibly indicated by Esmarch in his paper 'Der Antiseptische Dauerverband,' read at the last meeting of the International Medical Congress at Copenhagen.

These may be briefly summarised as follows:—

I. Making the wound as thoroughly dry as possible by a complete arrest of all hæmorrhage.

II. By the introduction of deep sutures and elastic pressure externally, preventing cavities or open spaces existing within the flaps.

III. Giving free exit to all wound-secretion.

IV. Maintaining, by the most careful precautions, a thoroughly aseptic condition of the wound, and of everything in close proximity directly or indirectly connected with it.

V. Employing a dressing by which moderate pressure on the flaps can be made, and which can readily absorb all wound-secretion.

VI. Giving rest and fixation (*Immobilisirung*) to the part operated on.

WILLIAM STOKES.

AMUSSAT'S OPERATION. *See* COLOTOMY.

AMYGDALITIS. *See* TONSILS.

AMYLOID DISEASE. *See* ALBUMINOID DEGENERATION.

ANÆSTHESIA.—The loss of sensation or of the sense of touch, whether from disease or injury: hence *local anæsthesia.* The term 'general anæsthesia' is usually applied to the state of unconsciousness produced by the administration of certain drugs known as anæsthetics.

ANÆSTHETICS.—Agents used for the suspension of sensation, and thus for the prevention of pain.

The chief use of anæsthetics in surgery is for the abolition of pain during operations; but some anæsthetics are also used for preventing reflex movements and for producing muscular relaxation, and are thus valuable aids to diagnosis and treatment.

Anæsthetics are either *local*—i.e. acting only upon the part to which they are applied; or *general*—i.e. rendering the person subjected to their influence entirely insensible.

Local anæsthesia is usually produced by the application of cold to the surface, whereby the part is sufficiently benumbed to admit of superficial operations of short duration being endured without pain. The most convenient method of freezing a part for operation is to direct upon it a finely divided spray of anhydrous ether. A portable spray-producer, which can be easily worked by the hand, is sold by the instrument-makers, and this being fitted to a small bottle containing the ether, a fine spray should be projected upon the part from a distance of about six inches, and with just sufficient rapidity to keep up a constant evaporation. The surface to be frozen should be dry, and the spray should be applied until the skin assumes a dead white colour, when it may be incised without pain.

It must be remembered that the vapour of ether is highly inflammable, so that the spray must not be used in conjunction with the actual cautery or in the neighbourhood of unprotected lights.

A similar degree of local anæsthesia may be produced by the use of a mixture of equal parts of pounded ice and common salt, which should be enclosed in a muslin bag, and kept upon the skin until the characteristic pallor is observed, which is usually in about five minutes.

This method can be applied to a somewhat larger surface than the ether-spray, but in either case the insensibility is but skin-deep, and lasts only a minute or two. This, however, is sufficient for a variety of small operations, such as opening an abscess, slitting up a sinus, or cutting off a pile; and, seeing that the chief pain of many more serious operations depends upon the incision through the skin, much suffering may be prevented by inducing local anæsthesia in cases in which, for any reason, the induction of general anæsthesia is undesirable. No harm results from such freezing, and the only inconvenience of the process is the toughness of the frozen tissues, which renders them more resistant to incision or dissection.

For producing anæsthesia of mucous surfaces, e.g. that of the eye or throat, the local application of a solution of muriate of cocaine has recently been used. A watery solution of 2 to 4 per cent. is suitable for use in operations upon the eye. A drop or two is applied to the inner surface of the lids three times at intervals of two minutes; in six or seven minutes the conjunctiva is sufficiently insensitive to allow of operations, such as that for squint or extraction of cataract, to be performed with little or no pain. Stronger solutions, as e.g. 20 per cent., may be used for painting over the laryngeal or other mucous surfaces, very decided temporary anæsthesia being thus produced.

General anæsthesia is obtained by the inhalation of certain vapours, which have the effect of producing insensibility without interfering with the essential vital functions.

The anæsthetics in common use are ether, chloroform, and nitrous oxide gas.

These differ materially both in their effects and in the mode of administration, so that it will be necessary to describe them separately, but there are some general principles which should be borne in mind in the administration of all anæsthetics.

In the first place there should be no impediment to free respiration, so that all tight clothing should be avoided, and the stomach should be empty. Whenever possible, the patient should be recumbent, and in an unrestrained and easy posture. Artificial teeth should be removed from the mouth, lest they become loose or displaced during insensibility. It is well also for the bladder to be emptied, since involuntary micturition is apt to occur.

The early morning, before breakfast, is as a rule the best time for taking anæsthetics, because abstinence from food is borne during sleep without inconvenience; and the rest of the night conduces to equanimity and calmness. The amount of an anæsthetic required to produce insensibility is in proportion to the quantity of blood in the person to whom it is administered. So that young children and anæmic persons require a proportionately smaller quantity than the full-grown and plethoric. Those addicted to alcohol or to much smoking take, as a rule, a large quantity of ether or chloroform; they usually struggle much, and are not good subjects for anæsthetics.

It is very desirable that the anæsthetic should be given by some one not concerned with the operation to be performed, so that his whole attention may be devoted to the maintenance of the proper degree of insensibility, and to the careful observation of the condition of the patient.

Ether.—This is at the present time the most generally used anæsthetic for operations of any considerable duration. It was the first anæsthetic systematically used for surgical purposes. But soon after the discovery of the method of so using it, and when the whole subject of artificially producing anæsthesia was in its infancy, chloroform was introduced and recommended by Sir James Simpson, as a more potent and convenient agent, and so, in Europe, ether for a time fell into disuse. In America, however, where it was first used, ether continued to be generally employed, and during the last ten years it has, in England, to a great extent taken the place of chloroform, on account of the general belief entertained of its greater safety. The greater safety of ether as compared with chloroform depends upon its stimulant effect upon the action of the heart.

The chief danger of chloroform is the possibility of its producing a sudden failure of the heart's action, and this danger does not pertain to ether. Ether, on the contrary, is a stimulant to the heart, and during inhalation of its vapour the pressure in the vessels is maintained, until there has been a manifest failure of the breathing.

This difference between the two drugs is of very great importance, because the failure of respiration, whilst the circulation is maintained, is a danger from which the patient may usually be recovered; but any considerable failure of the circulation involves the gravest peril.

Moreover, cardiac syncope is apt to occur with great suddenness, so that the absence of warning allows but little opportunity for averting the danger; whereas respiratory failure almost always takes place gradually, so that careful observation will generally lead to its recognition while it is still remediable.

Nevertheless, death has been known to result from the sudden failure of respiration, owing to the occurrence of an epileptiform spasm of the respiratory muscles, whereby the chest is fixed in the position of expiration. This is the only death from ether which the writer has witnessed during a large experience of its administration, both by himself and others; and unhappily nothing that was discovered, either at the time or at the post-mortem examination, gave any clue as to how the fatality could have been avoided.

Such cases are no doubt extremely rare, but they teach us that it cannot be rightly said that any anæsthetic is entirely free from danger. We can scarcely expect to render a person profoundly insensible without incurring some risk. This risk is certainly very small in the case of ether; but it is sufficient to point to the necessity of carefully watching the condition of everyone placed under the influence of an anæsthetic, and to deter the wise from the use of even the safest of these potent agents without due consideration and necessity.

In the administration of ether vapour for producing anæsthesia the chief precautions necessary to be observed are these:—

1. That kind of ether should be used which is fittest for the purpose of inhalation; and this is the pure anhydrous washed ether, of specific gravity ·720, free from alcohol and water. Methylated ether of sp. gr. ·735 answers perfectly well, however, and it is much cheaper and less volatile. The compounds sold as 'ether for local anæsthesia' are not suitable for inhalation.

2. The ether should be given in such a manner that the inhalation may be commenced with a very weak vapour, which, after a few inspirations, can be rapidly increased in strength. If we begin with too powerful a vapour the air-passages are intolerant of it, and the patient resists the inhalation; but, after a few moments' inhalation of a diluted vapour, its strength can be increased without inconvenience, and the patient rapidly brought under its influence.

3. Stimulants should not be administered before the inhalation. Ether is itself a stimulant, and can be safely given in cases where there is great depression or shock, but it is undesirable to have alcohol in the stomach when ether is being inhaled.

4. Whatever danger may belong to ether has relation to the respiratory function; the breathing should, therefore, be watched, and, should any embarrassment of this function arise, the inhalation should be stopped until the breathing is properly re-established. It is desirable so to place the head of the patient that the saliva (the secretion of which, as well as of the other glands of the mouth, is increased by the ether) may run out of the corner of the mouth rather than into the trachea.

Let it, above all, be remembered that, if any serious impediment to respiration occurs, the remedy which is, beyond all comparison with others, the most potent, is artificial respiration. The greatest care should of course be taken to ensure the absence of any mechanical obstruction to the free ingress of air to the lungs. The tongue should be pulled forcibly forwards and the finger passed to the back of the mouth, to ascertain that the passage is clear. But no time should be wasted in setting batteries to work, administering stimulants, or endeavouring to excite reflex movements. The important thing to be done is to at once commence artificial respiration, and, should air not then pass through the glottis, the windpipe should be opened without delay. Slighter disturbances of respiration may often be overcome by simply throwing back the head into the position of extension, and tilting forwards the chin. In other cases a little sticky mucus requires to be swept out of the back of the mouth with a sponge or towel. More serious obstruction may arise from vomited food lodging in the pharynx. It is always well, therefore, to have at hand a strong pair of flat-bladed forceps, with which the jaws can be opened and the tongue drawn forward, or any obstructing material seized.

In the absence of any special apparatus, ether may be easily administered by folding a towel into the form of a cone, into the apex of which is thrust a small sponge wrung out of hot water; about half-an-ounce of ether is poured on to the sponge and inner surface of the towel, which is then held over the patient's nose and mouth in such a way that (after the first minute, during which air is freely admitted) he breathes an atmosphere heavily charged with ether vapour, no more air being allowed to enter than can be drawn in through the apex of the cone or beneath the edge of the towel held firmly over the face. A fresh supply of ether must be frequently poured on to the sponge, for it evaporates quickly, but in this way insensibility can be produced in four or five minutes.

This, however, though an easily available method, is wasteful and disagreeable, for the ether is apt to run on to the patient's face, and much also escapes into the room. It is convenient, therefore, to use some one of the special forms of apparatus invented for the purpose.

A very simple one, introduced by the writer when he first advocated the use of ether, is a cone of thick felt covered with silk, between which and the felt is a layer of mackintosh cloth. The lower border of the felt is turned in to the extent of an inch, so as to make a thick soft edge to fit over the face, and to prevent the ether running on to the skin. The cone should be about eight inches high and its base four inches in diameter, and in its upper end should be placed a small soft sponge. Such cones can be made by anyone, are easily washed, and are very portable.

Improvements on these can, however, be obtained of the instrument-makers, of which the best are those invented by Mr. J. H. Morgan and the late Mr. Clover. Mr. Morgan's consists of a double cone, with valves so arranged that the expired air passes between the cones, and is carried to the floor by a tube. Mr. Clover's inhaler has an india-rubber bag communicating with the face-piece, and so connected with a vessel containing ether that the patient can be made to breathe, first the air in the bag, and then, gradually, air passed through the ether vessel, the strength of the vapour being modified by the amount of air passed through the ether.

The pleasantest and most rapid plan is to give first nitrous oxide gas to the stage of insensibility, and then to keep up the anæsthesia by ether. Mr. Clover invented an apparatus in which, by the turn of a valve, the vapour inhaled could be changed from laughing-gas to ether. The disadvantage of this method is the greater venous congestion which is thus produced.

The first effect of the inhalation of ether is a sensation of tingling and warmth throughout the body; the vapour is at first disagreeably pungent, and may excite cough; the air-passages, however, soon become accustomed to it, and the patient then breathes more deeply; after about two minutes sensation is much diminished and consciousness becomes clouded; then there often ensues a short period of struggling, which is succeeded by a gradual relaxation of the muscles and a condition of complete insensibility. When this is reached the eyelid may be raised and the conjunctiva touched with the finger without producing any movement of the lid. This, therefore, is a convenient test of the proper degree of anæsthesia having been attained.

Recovery from ether is sometimes characterised by a somewhat noisy or talkative stage of intoxication. It is well, therefore, to cover the eyes and encourage sleep. The taste of the ether is best got rid of by washing the mouth with warm water, in a tumbler of which a teaspoonful of eau de Cologne has been mixed.

Chloroform is doubtless a most convenient anæsthetic, and, in careful hands and with due precautions, may be given with very little danger. But it has the very great disadvantage that if given in too concentrated a vapour it is capable of producing a dangerous depression, or even a sudden arrest of the heart's action; a condition from which recovery is seldom possible, and which is responsible for the majority of the deaths that have occurred from chloroform inhalation. It would seem, moreover, that some persons are peculiarly susceptible to the action of chloroform upon the heart, so that to these even a small dose of the vapour may be dangerous. It is the opinion of the writer, therefore, that chloroform should only be used in cases to which, for some reason, ether is inapplicable.

For instance, the operation for cleft palate is much more conveniently performed under the influence of chloroform than of ether, because of the increased secretion of saliva and mucus which ether gives rise to, and the greater facility with which chloroform can be re-administered during the progress of the operation. Again the inflammable nature of ether vapour renders it under some circumstances inadmissible.

The chief care, then, in administering chloroform should be the avoidance of too concentrated a vapour, that is to say, of more than four per cent.; and this is to be attained either by using a vapour of measured strength, or by insuring the free access of air with the evaporated chloroform. By Clover's apparatus a mixture of chloroform and air is inhaled from a bag containing thirty-three minims of chloroform to each thousand cubic inches of air, so that a vapour of known and uniform strength is administered. A simpler, though of course less exact, method is to pour a drachm of chloroform upon a folded towel or handkerchief which is held over the patient's face loosely enough to allow air freely to mix with the evaporated chloroform. The patient should be brought gradually under the influence of the drug, by holding the cloth three or four inches from the face to begin with, and after a dozen inspirations, bringing it more closely over the mouth and nose. Twenty or thirty drops of chloroform are to be added from time to time as it evaporates.

Insensibility is produced in about five minutes, the same stages being passed through as with ether. The pulse and respiration should be watched, and on any failure of the pulse or obstruction of the respiration occurring, the chin should be thrown back and the tongue pulled forcibly forwards. Should this not suffice for recovery, artificial respiration should be at once resorted to. Especial care should be taken when the patient is struggling, lest, by a very deep inspiration and subsequent closure of the glottis, too much chloroform is suddenly absorbed into the blood.

Troublesome nausea and vomiting occasionally occur after taking chloroform, and less frequently, after ether. The best remedies are free ventilation of the room, maintenance of the recumbent posture, abstinence from food, iced water in teaspoonful doses.

Nitrous Oxide Gas.—This is an admirable anæsthetic for operations not lasting more than two or three minutes. It is very safe, not disagreeable, and is seldom followed by any discomfort.

It requires for its administration a special apparatus. This consists of an iron bottle containing the gas condensed into a liquid. An india-rubber tube is connected with the bottle, and by opening the communication, the gas escapes from the bottle into an elastic bag, from whence another tube conveys it to a face-piece through which it is inhaled. It is essential that the gas should be given pure and without the admixture of air, for such a mixture produces the exciting and intoxicating effects which gave it the name of 'laughing gas.' The margin of the face-piece must therefore be enclosed by an air-cushion, to ensure its fitting so accurately to the face that no air can enter.

The bag being filled with gas, the face-piece must be applied and pressed firmly to the sides of the nose and round the mouth; the patient is then directed to close the eyes and to take slow deep inspirations, the communication with the gas-bag being at first closed. Immediately after the first complete expiration the gas should be turned on to the face-piece, and thus, the lungs being emptied, a full dose of gas is at once inhaled, a gentle stream of gas being allowed to flow into the bag, so that respiration is carried on without effort. In about a minute the patient is insensible; the blood is darkened, the surface becomes extremely livid, the breathing stertorous, and slight convulsive movements occur; the eyelids are insensitive and the pupils dilated. The gas must now be removed and the operation at once proceeded with.

As soon as the gas is withdrawn, recovery begins, and at the end of two or three minutes the patient is quite himself again. If necessary, however, insensibility may be prolonged by removing the face-piece, admitting air for two inspirations and then again giving the gas, repeating such intermission from time to time when the breathing becomes stertorous. This should only be done, however, on emergency, for if longer anæsthesia is required it is better to supplement the gas with ether. Moreover the gas cannot be depended upon for producing perfect quietude; there are almost always slight jerky movements, and young people often pass into a condition of complete opisthotonos when deeply under its influence.

For operations upon the mouth, such as the extraction of teeth, it is necessary to prop open the jaws by a wedge fixed between the upper and lower teeth, before the inhalation of gas is commenced; otherwise the jaws would become tightly closed and access to the back of the mouth be prevented. Ordinarily, no disagreeable effects follow the inhalation, although vomiting is occasionally produced in pregnant women. Abstinence from food is of less consequence before inhaling gas than when other anæsthetics are to be taken, yet it is preferable that the stomach be empty, so that respiration may be as deep as possible. To take alcohol before inhaling the gas is dangerous.

Should faintness ensue, or any delay in recovery occur, the patient should be placed recumbent, and artificial respiration performed.

Other anæsthetic compounds have occasionally been used, which are mostly of unstable composition and less reliable than those above mentioned.

Bichloride of Methylene is a compound of chloroform which has been a good deal used in ophthalmic surgery, and by Sir Spencer Wells for ovariotomy and other abdominal operations. Very similar to this is a mixture of one part of alcohol, two of chloroform, and three of ether, which has been by some recommended. The instability of these compounds is objectionable, and they appear to possess no advantage over the other anæsthetics described in this article. J. Warrington Haward.

ANALGESIA.—The loss of the sensation of local pain.

ANAPHRODISIA. *See* Impotence.

ANCHYLOSIS. *See* Ankylosis.

ANEURISM may be defined as a pulsating tumour in direct communication with an artery, since that is its condition when it comes before the surgeon for treatment, although under certain conditions an aneurism does not pulsate. The existence of an aneurism, apart from a wound of the vessel with which it is connected, presupposes disease of the arterial coats (*see* Arteries, Diseases of); for a healthy artery would not admit of dilatation sufficient to form a sac, nor would it give way under any reasonable exertion on the part of the patient. Given a diseased condition of the arterial coats, they may yield spontaneously to the pressure of the blood impelled forcibly against them, as in the transverse portion of the arch of the aorta; or may be stretched and weakened by the constant movement of a neighbouring joint, as in the case of the popliteal artery. In the great majority of aneurisms, however, there is a distinct starting-point of the disease connected with some strain or over-exertion, during which the patient is conscious of a crack or giving way of tissue, in the region where an aneurism subsequently shows itself.

The division of aneurisms into 'true' and 'false' is somewhat complicated by the different views held as to the use of those terms. The existence of any aneurism, in the walls of which all the coats of the artery are to be found is very doubtful, and for all practical purposes a 'true' aneurism may be defined as one in which the blood is contained within the arterial walls, however thin they may be; while a 'false' aneurism has its walls formed by condensation of the tissues surrounding the artery, and is therefore for the most part traumatic.

Aneurisms are rarely *fusiform* or formed by dilatation of the whole circumference of an artery, but are in the great majority of instances *sacculated*, there being a distinct pouch arising from one side of the artery having an aperture of communication with the interior of the vessel. It is by the gradual formation of this sac that the characteristic symptoms of aneurism are produced; and a fatal result is commonly due to rupture of the sac, either externally or internally, or to pressure upon vital parts by the increasing size of the tumour. Occasionally, in the case of the aorta, the coats of which are especially liable to atheroma, the blood finds its way between the middle and external coats of the vessel, splitting them asunder for some distance, and forming an elongated pouch or *dissecting* aneurism, which may or may not have a second communication with the interior of the artery.

As the result of a wound, or more rarely spontaneously, an aneurismal sac may form between an artery and a vein, forming an Arterio-Venous Aneurism.

Causes.—From what has been said it is obvious that the causes of aneurism are divisible into predisposing and active. Conditions of the system tending to arterial disease must conduce to aneurism, and foremost amongst these may be placed intemperance and syphilis. The undoubtedly greater liability of men over women to suffer from aneurism is partly to be explained by the greater prevalence of chronic intemperance and of constitutional syphilis among the former; and partly by the greater physical exertion which the male sex is liable to in various employments. This is especially seen in the case of soldiers, who, besides being the subjects of intemperance and syphilis, are often called upon to make violent exertions, suddenly, under very unfavourable circumstances as regards their clothing. The tight uniforms and rigid stocks of former years had much to answer for in the production of thoracic aneurism, and the lightly clad sailor, though probably equally diseased, has been found to be much less liable to that disorder than the soldier. Obstruction of an artery by its being plugged with an *embolon* or some vegetation loosened from one of the valves of the heart is undoubtedly a cause of aneurism of the smaller arteries, particularly in the brain or the branches of the external carotid. This may occur in young persons, but as a rule true aneurism is a disease of middle life, when the atheromatous changes in the arterial walls are progressive; whilst false aneurism is more likely to occur spontaneously in more advanced years, when the walls of the arteries have become calcareous and brittle, and are therefore liable to rupture on sudden exertion.

Symptoms.—The symptoms of an aneurism in a limb are fairly obvious, the pulsating swelling usually first attracting the patient's notice; but this may come on so insidiously that popliteal aneurisms have often been found, accidentally, in a patient previously unaware of the existence of any swelling. The distinct *pulsation* of a swelling in the position of a main artery at once raising the question of aneurism, its direct communication with the vessel should be ascertained by making pressure upon the artery nearer the heart, when all pulsation in the tumour should abruptly cease. Now, gently grasping the tumour with his hand the surgeon slightly compresses it, and on relaxing his hold of the artery above is at once conscious of the *distensile expansion* characteristic of aneurism; for although in rare cases of cancer a tumour may, after compression, become distended with blood and eventually pulsate, the time thus occupied is much longer than in true aneurism. The ear or a stethoscope applied to the tumour will now, in the great majority of aneurisms, detect a distinct *bruit*, synchronous with the pulse in a healthy limb, and it is hardly possible to confuse this with the much feebler sound produced by mere pressure on a superficial artery with the edge of a stethoscope.

In internal aneurisms the effects of the pressure of the sac upon important structures must often precede the appearance of any tumour externally. Hence *pain*, which is often by no means marked in aneurisms of the limbs, is a constant and early symptom in internal aneurisms, whether of the chest or abdomen. The pain being due to pressure upon the trunks of nerves is reflected to their peripheries; thus, intercostal pain may be caused by an aneurism of the thoracic aorta, and pain down the thigh by iliac aneurism. In the case of aneurism of the arch of the aorta or of its primary branches, pressure-effects upon the function of important nerves are often well-marked; thus aphonia, from pressure on one recurrent laryngeal nerve with corresponding paralysis of the laryngeal muscles, is frequently met with; or dyspnœa from spasm of the laryngeal muscles due to irritation of the pneumogastric trunk. The mechanical effects of the pressure of an aneurism upon the blood-vessels and other structures is also commonly seen in enlargement of the superficial veins of the thorax and abdomen or in œdema of the limbs, and in the dyspnœa and dysphagia caused by pressure upon the trachea or bronchus and upon the œsophagus.

The effect of dilatation of an artery is to diminish the force of the pulse beyond. Hence the pulse in an aneurismal artery is smaller than in the healthy limb, and this is usually perceptible to the finger, but may be more thoroughly appreciated by the use of the sphygmograph, the tracing of the aneurismal artery having for the most part lost the abrupt rise and fall of health, and being rounded in form.

Diagnosis.—In the majority of external aneurisms the diagnosis is easy, whilst in internal aneurisms it is always more or less obscure, both as to the nature of the tumour and the vessel involved. There are, however, certain fallacies in external aneurisms to be guarded against, and these are to be avoided mainly by attention to the symptoms detailed above. (1) An abscess or any cyst, in close relation with an artery, may have pulsation so transmitted to it as to cause it to resemble an aneurism; but the pulsation is not expansile, there is no *bruit*, and the history is not that of aneurism. (2) An artery may be so raised by any tumour beneath it as to resemble an aneurism, and the pressure may produce a spurious *bruit*; but the pulsation will be found to exist only in the line of the vessel, to be non-expansile, and to diminish rather than to increase with the growth of the swelling. (3) A soft malignant tumour, usually connected with bone, may pulsate and even have a *bruit*; but its size can be in no way influenced by pressure on the main trunk, although it may cease to pulsate, and when emptied by manipulation it refills more slowly and with a gradually increasing force of impulse, quite unlike that of an aneurism.

Aneurisms may have *ceased to pulsate* from having become consolidated, i.e. cured; or from having given way and become diffused. The first condition is obviously one of no urgency, and time will show that the tumour is decreasing rather than increasing in size. The second is usually accompanied by such marked symptoms as to be unmistakable.

The giving way of an aneurism externally or into an internal cavity is a necessarily fatal event, marked by sudden faintness and death-pallor; but an aneurism giving way into the tissues of a limb, though sufficiently serious, is amenable to treatment. The symptoms of shock, the sensation of something giving way, and the swollen condition of the limb, which is cold and in which no pulsation is to be detected, sufficiently mark the occurrence. If the extravasation of blood is small it may so compress the aneurism as to induce spontaneous cure, but if large it will almost certainly induce gangrene of the limb, with probably septicæmia and death. The treatment must necessarily at first be expectant, the limb being elevated to favour the return of venous blood, and its temperature being maintained without being unduly raised. Should no symptoms of gangrene supervene, the careful support of the tissues by bandaging, and the observance of complete rest until all the extravasated blood is absorbed, will alone be required to complete the cure, which must necessarily be a tedious one. When, however, gangrene shows itself, there should be no hesitation in amputating promptly above the aneurism, as the best means of saving the patient's life. There is a certain small number of recorded cases in which ligature of the main artery above a ruptured aneurism has been followed by recovery, with or without amputation; but these are more than counterbalanced by the very large number of cases in which a fatal event has followed the operation. The probability is, that the cases which survive ligature of the main artery without amputation would have recovered equally without any operation at all.

Prognosis.—The tendency of all aneurisms is to increase in size with thinning of the wall at some point where resistance is weakened. Hence, internal aneurisms tend to burst into serous cavities or into mucous canals, whilst external aneurisms cause absorption of overlying structures by their pressure, and eventually burst by ulceration of the skin, or become diffused beneath the integuments. Occasionally, no doubt, under favourable circumstances, an aneurism may become cured spontaneously, or, at least, may cease to increase in size and become solidified by deposit of laminated fibrine upon the wall of the sac. Such a result cannot be counted upon, and a patient the subject of aneurism must be made to appreciate the extreme gravity of his condition and the necessity for submission to appropriate treatment.

Cure.—The mode of cure of aneurism was until recently believed to be, in all cases, the slow deposit of laminated fibrine, which is known to occur spontaneously in the sacs of aortic aneurisms. But it has of late been shown that coagulation of the contents of an aneurism may occur both accidentally and as the result of treatment, and that it probably occurs to some extent in all cases, whether a previous deposit of laminated fibrine has taken place or not. In the great majority of cases this mode of cure causes an obstruction of the calibre of the artery, which thereupon ceases to pulsate, but there are a few examples of cured aneurisms in which pulsation of the main artery has continued unimpeded. This can, of course, only occur in well-marked sacculated aneurisms.

Treatment.—(1) *General.* — The most important element in the treatment of all aneurisms is Rest. It is not only that rest will give the best opportunity for the deposit of fibrine and the coagulation of the diminished contents of the sac, but that rest is essential to diminish the force of the circulation and prevent the washing away of coagulum already formed. A patient suffering only from an external aneurism should be kept in bed for a day or two before active surgical treatment is begun. Diet is the next most important element, and should be limited in quantity and carefully regulated as to quality, the object being to favour the coagulation of the blood without stimulating the heart. About ten ounces of solid food, composed of well-cooked meat and biscuit, with half a pint of milk and no stimulants, may be taken as a standard dietary, but many patients cannot bear so low a scale. As regards medicines all that can be said is, that there are many drugs that have a reputation which they do not appear to deserve, as adjuvants in the treatment of aneurism. First, and probably oldest, is Digitalis, by which undoubtedly the action of the heart may be depressed, but with increase of arterial tension. Iron has been held to improve the quality of the blood and favour coagulation. Iodide of potassium and Acetate of lead have been thought to be beneficial, but with doubtful effect; and Ergotine has been injected subcutaneously on the theoretical view of contracting the muscular coat of the aneurism, which has little or no existence. Sedative medicines, such as Morphia, Indian hemp, and Bromide of potassium, are undoubtedly of service in calming the nervous system, relieving pain, and favouring that equable condition of the circulation which is most likely to induce coagulation of the contents of an aneurismal sac.

(2) *Local.* —*Pressure* is the treatment most immediately indicated in the case of aneurisms of the limbs, where the main artery can be controlled on the proximal side of the sac. With the older view of the method of cure before them, and with the successful practice of the Dublin hospitals to support it, surgeons were until recently in the habit of resorting to mechanical means of modifying, rather than of arresting, the flow of blood through the main artery of a limb. Two of Signoroni's tourniquets, or the more elaborate apparatus of Carte, were applied over the femoral artery, and were regulated so as to allow of a flow of blood through a popliteal aneurism sufficient to give slight pulsation in the sac. Applied in this way for twelve or fourteen hours, a cure is sometimes, no doubt,

promptly effected; but in the majority of cases it is necessary to remove the instruments in order to allow of the patient sleeping, and to resume the treatment on the following and perhaps for several consecutive days, before a cure is effected, if at all.

Digital pressure by the fingers of assistants, aided by the use of a heavy weight to relieve their muscular strain, is a more efficient method, and may be adopted either after the employment of instrumental pressure or alone. In this case the circulation through the main artery is completely stopped, and presumably the blood in the aneurism is at rest and in a condition favourable for coagulation. Certainly many cases are now on record, in which complete cure of popliteal aneurism has been effected by digital compression in from seven to ten hours.

Local pressure upon the sac of an aneurism must be of very limited application, from the risk of bursting the sac. Mr. Holmes has recorded a case of subclavian aneurism in which benefit was derived from the pressure of an india-rubber air-ball bandaged into the posterior triangle of the neck; and the method of *flexion* of the knee, recommended for the treatment of popliteal aneurism by Mr. Hart, necessitates some pressure of the sac and through it of the artery. *See* POPLITEAL ANEURISM.

Rapid pressure—i.e. the complete arrest of the circulation through the sac of an aneurism for a limited time under the influence of an anæsthetic—was first successfully employed by Dr. Murray, of Newcastle, in a case of abdominal aneurism. *See* ABDOMINAL ANEURISM. The more modern method adopted in the case of the limbs, is Dr. John Reid's application of Esmarch's elastic band and tourniquet to secure complete stagnation of the blood, in both the arteries and veins of a limb, whilst coagulation of the contents of the sac of the aneurism is going on. In employing the method with Esmarch's bandage the writer thinks it essential that the sac should be full of blood; and he therefore recommends that the elastic bandage should be applied from below upwards and also from above down to the sac, in addition to the application of the elastic cord. By this plan the sac is rendered tense, the best proof of which is the production of slight subcutaneous ecchymoses, and coagulation of the contents is materially assisted. There is undoubtedly a risk of gangrene in this method which ordinary digital and instrumental pressure do not involve, and its use should be confined to the cases of small aneurisms in young subjects. *See* POPLITEAL ANEURISM.

The time during which stagnation of the blood in a limb may be safely kept up cannot be accurately ascertained, but the writer has maintained it for three and three and a-half hours respectively, without bad result and with complete cure of popliteal aneurisms. Less than two hours cannot be expected to cure the aneurism, and in any case it is advisable to moderate the flow of blood through the artery by means of a screw tourniquet, for some hours after removal of Esmarch's apparatus, lest the soft and recent coagulum should be displaced and the cure be undone.

The Ligature, applied to the main artery of the limb in which an aneurism is situate, is the most efficient way of applying pressure to the vessel and of producing coagulation of the contents of the sac.

The Hunterian operation, in which a ligature is applied on the proximal side of the sac, but at some distance from it, and with one or more branches intervening to carry on the collateral circulation, is of universal application in the case of the limbs. The distance from the aneurism secures, in the great majority of cases, a healthy vessel, and the application of a ligature, whether of hemp, silk, or catgut (*see* LIGATURES), leads, as a rule, to permanent obliteration of the artery at that spot. The immediate effect of tying the main artery is to lower the temperature of the limb and to arrest pulsation in the aneurism, which becomes less tense than before. The sac is not emptied, however, and care should be taken that it is not over-manipulated at the time of the operation, lest the sac should be burst if thin, or be irritated so as to become inflamed. In all cases in which, after ligature, blood is left in the sac, it no doubt coagulates; and these are the cases in which pulsation does not recur, and in which a cure is rapidly and easily produced. In other cases, especially where the aneurism partakes of the fusiform rather than the saccular form, there is little if any coagulum, and cure is brought about later on by deposit of fibrine from the collateral circulation, aided, probably, at the last moment, by coagulation of the small central channel of blood. In these cases a pulsation may be detected in the sac in from twelve to thirty-six hours, at first very feeble, then becoming more forcible, and finally dying away again with permanent consolidation of the sac. But occasionally, and particularly in patients who have been submitted to prolonged compression-treatment unsuccessfully, the collateral circulation is so enlarged that pulsation returns very shortly after ligature, and persists until the aneurism is found to pulsate as forcibly as before the operation. Under these untoward circumstances recourse must be had to pressure both on the sac and below the seat of ligature, and probably the careful application of Esmarch's bandage offers as good a prospect of cure as any plan of treatment. Failing thus to effect consolidation, should the sac begin to increase and threaten to burst, the surgeon had better resort to amputation between the aneurism and the seat of ligature.

Giving way of the sac of an aneurism may follow immediately upon the operation of applying a ligature to the main artery, and is then due to the over-manipulation of an already attenuated sac; or may occur at a later date from inflammation of the sac with suppuration of its contents. In these cases all will depend upon the condition of the contents of the aneurism. If the extravasation occurs immediately after the application of the ligature, gangrene is almost certain to supervene and necessitate amputation; but if the contents of the sac have already become consolidated, suppuration may occur and matter may be evacuated, with complete recovery, although with considerable risk of the occurrence of secondary hæmorrhage.

Gangrene of the limb may follow the application of a ligature for the treatment of aneurism, and may be moist or dry. *See* GANGRENE. The latter form, depending simply upon insufficient supply of arterial blood, shows itself first in the toes, which become dark and shrivelled, and may eventually be removed, leaving a very useful limb. The moist variety, depending upon obstruction of the venous circulation due either to pressure of the aneurism or some interference with the main vein at the seat of the operation, is a much more serious affection, involving the whole limb, and exposing the patient to great risk of the occurrence of septicæmia. Early amputation above the aneurism offers the best chance of saving the patient's life.

Temporary ligature.—Attempts have been made from time to time to apply ligatures temporarily to a main artery, and various contrivances have been invented with this object in view but have all fallen into disuse. The catgut ligature of Lister and the flat ox-aorta ligature of Barwell are to a certain extent temporary ligatures, and the former has on more than one occasion disappeared too rapidly for a cure of the aneurism to be effected. *See* LIGATURES.

Distal Ligature.—In the case of aneurism of the arch of the aorta and its primary branches, the practice of applying a distal ligature to one or more of the great vessels has met with a fair amount of success. The original proposal of Brasdor was, to place a ligature beyond an aneurism in cases in which deligation on the proximal side was impossible; but it was left to Wardrop to bring the method to the test of practice, by tying the common carotid for carotid aneurism low down (1825). Subsequently Wardrop extended the practice to the subclavian artery, which he tied successfully for innominate aneurism (1827), thus showing that the presence of large branches between the aneurism and the seat of ligature was no bar to the proceeding. Consecutive ligation of the carotid and subclavian for innominate aneurism was undertaken by Fearn, of Derby (1836–38), with success; and simultaneous deligation of the two vessels, for aneurism which proved to be aortic, by Hobart (1839), unsuccessfully, and for innominate aneurism, also unsuccessfully, by Rossi (1843). In 1865 the writer revived the practice by successfully tying the carotid and subclavian in a case of aneurism, supposed to be innominate, but which proved to be aortic upon the death of the patient four years later; and his example has been followed by other surgeons, and notably by Mr. Barwell, who also, in 1879, first employed the double distal ligature in a case of aneurism, diagnosed as aortic. In 1872, upon the suggestion of Dr. Cockle, the writer tied the left carotid in a case of pure aortic aneurism, with great relief to the patient, who survived four years and a half, and the operation has been repeated a few times with encouraging results. *See* AORTIC ANEURISM; INNOMINATE ANEURISM.

There has thus, within the last twenty years, been accumulated a good deal of experience as to the applicability of the distal ligature under various conditions, and on the whole the experience is encouraging. At the same time it is not easy to explain the *rationale* of the treatment. Brasdor's original view, that, by obstructing the vessels, coagulation of the contents of the sac might be induced, can only apply to the case where no branches intervene, and Mr. Holmes' suggestion that coagulation spreads backwards from the seat of ligature is not supported by facts. Wardrop's idea also, that cutting off from the aneurism the exit of two-thirds of the blood passing into it tends to cause coagulation of the other third is hardly tenable, since the full quantity finds its way into the sac as before. It appears to the writer that the most reasonable explanation is that the *direction* of the current of the blood in the sac being probably modified by the application of a distal ligature, there is a greater tendency for it to deposit fibrine than before, and thus to fill up the cavity. It must be admitted, however, that this theory is purely speculative.

Allied to distal ligature are two methods of treatment of aneurism suggested by Sir W. Fergusson. By *manipulation*, or handling of an aneurismal sac, that surgeon proposed to produce an artificial embolism of the artery beyond, and succeeded to a certain extent, in two cases of innominate aneurism, but with the drawback of producing head-symptoms, from embolism of the cerebral arteries. The other proposal was, in desperate cases of subclavian aneurism, to amputate it at the shoulder-joint, and thus perform distal ligature. The writer, having witnessed Sir W. Fergusson's original operations of manipulation, and having, on one occasion, employed the method by amputation, cannot recommend either for adoption.

The treatment hitherto considered has dealt mainly with the artery in which the aneurism is situated; but in cases which have resisted that form of treatment, attempts have been made from time to time to attack the contents of the sac itself. The *injection* of coagulating fluids, and especially of a solution of perchloride of iron, has been tried in a few cases with negative or disastrous results from embolism. The *introduction* of fine needles, in order to entangle fibrine has been tried with some benefit (*see* ACUPUNCTURE), and the same may be said of the addition of a *galvanic current*. *See* ELECTROLYSIS. The introduction of iron wire and of horsehair into an aneurism, with the view of entangling clot, need only be mentioned as having been tried unsuccessfully.

TRAUMATIC ANEURISM is the result of a puncture or rupture of an artery occurring some time before, the blood being enclosed in a cavity formed by the surrounding structures, and the external wound, if any, being generally healed. Pulsation will be present both in the tumour and in the artery below it, and a very loud *bruit* is generally to be heard over the swelling. If small, traumatic aneurisms are no doubt amenable to treatment by perfect rest and carefully adapted pressure over the tumour; but if of large size when first seen, or rapidly increasing in size, prompt surgical interference will be required. The *treatment* is the same as for a wounded artery, viz., to tie the artery above and below the injured spot; but this operation is rendered much more difficult than in the case of a recently wounded artery by the presence of a distinct sac containing clot and overlying the artery involved. The main danger is hæmorrhage, and in the case of the limbs this can be best guarded against by employing Esmarch's bandage (*see* ESMARCH'S BLOODLESS METHOD), and a good screw-tourniquet, so as to render the parts bloodless whilst the operation is being performed. If this is impossible, as in the case of the iliac or axillary artery, digital pressure on the main artery must be made, and the operator must be prepared to thrust his finger into the opening in the wounded artery and to plug it whilst operating with the other hand.

The sac being laid open by a free incision, the clot is to be rapidly turned out, and if there is hæmorrhage it must be at once arrested. The operator has now to dissect or scratch through the wall of the sac immediately above and below the aperture of communication with the artery, in order to pass two ligatures around the vessel and thus secure it. If there is no hæmorrhage it will greatly facilitate this part of the proceeding to introduce a good-sized bougie or catheter into the artery, so as to gain an idea of its position and depth. A very cautious dissection being then made through the sac of the aneurism half-an-inch above the opening, an aneurism-needle is carried round the artery distended by the bougie, which is then withdrawn, and the ligature is tied. The same steps are repeated below the opening. If, on relaxing the tourniquet, there is no bleeding, the operation is completed; but if there is, search must be made for the bleeding spot and the vessel must be secured.

The term *diffuse traumatic aneurism* is sometimes erroneously applied to cases of recent wound or rupture of a large artery, in which a large quantity of clotted blood is extravasated into the tissues of the limb. There will be found no pulsation in the swelling or in the arteries below the seat of the injury, and the whole limb is cold and congested. The treatment is the same as that described above, but the operation will be easier because the wounded or ruptured artery will be more readily found. At the same time the damage done to the soft structures is so great that the propriety of amputation must always be considered.

particularly if there is reason to suspect that a ruptured artery has communicated with the cavity of a large joint, or if the main vein is found also to be torn. *See* Arteries, Rupture and Wounds of.

Christopher Heath.

ANGEIECTASIS. *See* Lymphangitis.

ANGEIOLEUCITIS. *See* Lymphangitis.

ANGEIOMA. *See* Nævus.

ANGULAR CURVATURE. *See* Caries of the Spine.

ANIMAL POISONS. *See* Glanders; Hydrophobia; Malignant Pustule, &c.

ANKLE, Dislocations at the.—Dislocations at the ankle-joint are five in number, viz. outwards, inwards, backwards, forwards, and upwards. These directions apply to the position of the foot, which, being farther from the centre of the body than the tibia, is regarded as the part dislocated. Astley Cooper, Malgaigne, and some others have spoken of the tibia as the bone displaced, and with some reason, inasmuch as the foot is usually fixed on the ground before the ligaments yield and allow the tibia to be displaced from its position. But it is more convenient to regard the foot as the part dislocated.

Dislocations at the ankle are more frequently partial than complete, it being comparatively seldom that the articular surface of the tibia is completely separated from that of the astragalus. When this does happen, the dislocation is usually compound. The partial lateral dislocations result from rotations of the foot upon an antero-posterior axis. The ligaments on one side are thus torn through, and the joint-surfaces gape on the same side. Further, dislocations of the ankle-joint are peculiar, in that they are usually associated with fracture, the fibula frequently, and the tibia sometimes, giving way under the force producing the displacement.

Dislocation Outwards.—Partial dislocation of the foot outwards, with fracture through the lower third of the fibula, is by far the most common dislocation of the ankle-joint, and is often spoken of as Pott's fracture. It is occasioned by forcible abduction of the foot, and often results from simple falls in the street, such as may happen in slipping from the kerbstone. The weight of the body is suddenly directed through the inner ankle, and, as a consequence, the internal lateral ligament gives way, or the tip of the inner malleolus is broken off; the outer surface of the astragalus then bears heavily upon the outer malleolus, and the fibula is fractured from two to three inches above the articular surface of that process. After fracture of the fibula, the fractured end falls in towards the tibia, and the malleolus becomes everted. Thus is produced, to use Pott's own words, 'a perfect fracture and a partial dislocation.' The clinical signs are, eversion of the foot, prominence of the internal malleolus, and a depression on the outer side of the leg corresponding to the fracture of the fibula, at which point crepitus may be elicited on manipulation. Blood-extravasation, and swelling from intra-articular effusion, rapidly follow.

Rupture of the internal lateral ligament, or fracture of the internal malleolus, and fracture of the fibula, are the only pathological lesions usually admitted to occur in Pott's fracture; but the increased width between the malleoli, often noticeable, suggests something more, either rupture of some of the ligamentous connections between the outer malleolus and tibia, or a splitting off of a portion of tibia with the outer malleolus. This almost vertical fracture of the tibia was found to have occurred in two cases which the writer has had the opportunity of dissecting. It commences at the outer part of the articular surface of the tibia, and appears on the outer surface of that bone above the interosseous tibio-fibular ligaments. One of the cases alluded to was a recent case, the patient having died of more serious injuries; the other was a case in which the deformity had remained permanent, and had necessitated the wearing of an iron support. The latter case was examined fourteen years after the injury, and the line of fracture could still be traced. Moreover, the fibula below was found firmly ankylosed to the tibia by bony outgrowths, showing that nothing short of osteotomy could have corrected the deformity after reparation had taken place. It is probable that this fracture of the tibia may occasionally give rise to difficulty in reducing the dislocation, and the prolonged convalescence often noticed after Pott's fracture may be due to the fracture into the joint.

When the dislocation of the foot is complete, the lower end of the tibia usually bursts through the skin on the inner side of the ankle, and the dislocation thus becomes compound; but the writer has himself seen the foot thrust out at right angles to the leg without this accident occurring; and it is even said that complete simple dislocation outwards has occurred without fracture of the fibula.

The *reduction* is usually easy. The leg is placed at right angles to the thigh, to relax the gastrocnemius muscle; one hand then presses the tibia outwards, whilst the other is used to draw the foot inwards. It is unusual to find any obstacle to reduction. The deformity having been overcome, the limb may be put up in three splints as in ordinary fractures of the leg, but the outer splint should have its foot-piece thickly padded to press the foot inwards, and the inner splint should be so padded as to press the tibia out.

Dislocation Inwards, though next in frequency to dislocation outwards, is nevertheless a rare accident, and, since greater violence is required to produce it, is more serious. This dislocation is caused by a fall on the outer side of the foot, or by a cart-wheel passing over the ankle. The foot is thrown inwards, whilst the outer malleolus projects prominently beneath the skin, and the foot and toes point downwards. The inner malleolus, against which the astragalus is driven, is split off from the shaft of the tibia in an upward and inward direction, and the astragalus itself may sometimes be fractured. The outer malleolus may also be fractured, or its ligaments torn through.

Reduction is made by first flexing the leg on the thigh, then making extension on the heel and instep whilst pressing the foot outwards. After reduction, Astley Cooper recommends that the leg be laid upon an outside splint, which is padded so as to press on the fibula above the malleolus, and relieve the skin over that process from injurious contact. It may be more conveniently swung in three splints, taking care to prevent recurrence of the deformity by arranging the pads in such a way as to keep the foot straight and at right angles to the leg. The limb should be taken down and passive movement be commenced about six weeks after the injury.

Dislocation Backwards gives rise to an appearance of shortening of the foot, whilst the heel is unduly prominent behind, and the hollow spaces in front of the tendo Achillis are exaggerated. The tibia forms a firm projection beneath the anterior tendons, which are tense, and the toes are pointed downwards. It may be caused, like sub-astragaloid luxations and dislocation of the astragalus forwards, by over-extension of the foot on the leg, or by stepping from a vehicle in rapid motion. The dislocation backwards may be partial or complete. In the former case, the tibia rests partly on the articular surface and partly over the head of the astragalus and the scaphoid. When complete, the tibia passes forward and rests over the navicular and cuneiform bones. According to Hamilton, a partial dislocation may be consecutive to severe sprain and fracture of fibula, being brought about by the action of the muscles of the calf, but such cases should be regarded with some suspicion, as the great swelling present after these severe injuries may readily obscure, at first, a partial displacement. Whilst the tibia passes forward over the scaphoid, the fibula gives way above the malleolus, and this process is retained in its normal relation to the tarsus by its three strong ligaments. In a case dissected by the writer the extreme posterior edge of the articular surface of the tibia was found chipped off. The malleolus of the tibia may also be found broken.

To *reduce* this dislocation the leg should be flexed, and the heel being drawn forward by one hand, the other is used to press the tibia back into position. Should difficulty be experienced, the tendo Achillis may be divided. Though little difficulty has been met with in reducing the dislocation, there is in this form a tendency to reluxation, which must be guarded against. Pressure, directed so as to push the os calcis forward and the tibia backward, at once suggests itself, but, if attempted, must be carried out with the greatest caution, as both these bones are subcutaneous, and sloughing of the skin is likely to follow any but the gentlest pressure. It might be done with hollowed layers of thick felt plaster.

Dislocation Forwards causes lengthening of the foot and diminished prominence of the heel. At the same time, the leg is somewhat shortened, and the malleoli will be found lower than normal. The depressions in front of the tendo Achillis are filled by the displaced tibia, and in front of the joint the trochlear surface of the astragalus may be felt. It is a very rare injury, there being only six cases on record. Extreme flexion of the foot on the leg appears to be the primary cause, which is usually aided by some additional force applied over the tibia. Great difficulty has been experienced in attempts to reduce this dislocation, but a case recorded by Poland, in the Guy's Hospital Reports for 1855, seems to indicate that division of the tendo Achillis is what is required in order to effect reduction.

Before this was done, all attempts, even under chloroform, had failed. After reduction, the limb should be secured on a back splint with a footpiece, and there should be a hole in the splint large enough to receive the heel, so that it nowhere rests on the wood.

Dislocation Upwards, which is sometimes called 'Nélaton's dislocation,' is usually caused by a fall from a height on to the sole of the foot. Two cases have been described by Fergusson, and one by De Morgan; two, also, are mentioned by Bryant, one of which was double. In this injury the fibula is forcibly detached from its connections with the tibia, and the astragalus is driven up like a wedge between them. The inner malleolus and articular end of the tibia form a very prominent swelling, tightly stretching the skin on the inner side. The foot is usually everted, and the malleoli approach the ground, so that the limb is shortened. Reduction has generally been effected by extension, but in some cases all attempts to restore the parts to their normal positions have failed. The leg being flexed on the thigh, and held by an assistant, the surgeon should seize the instep and heel and attempt, by extension and to-and-fro movements, to disengage the astragalus. When reduced no tendency to reluxation has been noticed. Should the means described fail to reduce the dislocation, it may be justifiable to place a loop over the heel and instep, and make gradual extension by means of pulleys. But great care should be taken not to damage the soft parts and so occasion sloughing. When reduced, the limb should be secured between two side splints, and be thus retained for three weeks or a month, when passive movements may be commenced.

Compound Dislocation of the Ankle-Joint is a very serious injury, but not one by any means of necessity requiring amputation. Amputation is indicated when the dislocation is accompanied by much crushing or laceration of the soft parts, and distinct splitting of bone. It is required especially in cases caused by heavy wheels passing over the joint, and, less often, in those resulting from violent strains. The age and constitution of the patient should also be taken into consideration; for delicate and aged persons may succumb under the suppuration an attempt to save the foot may subject them to. Excision of the joint is suggested when there is a large opening freely exposing the articular surfaces, and when the bone protrudes through an opening too small to allow of its being reduced. In the latter case, many surgeons would be content to saw off only such an amount of bone as would allow of reduction. At the ankle the malleoli are apt to interfere with drainage, and the removal of the protruding process provides for this important aid to recovery; but it should be remembered that after removal of the external malleolus there is a tendency to abduction of the foot. In the simplest cases, where the wound is small, the dislocation may often be converted into a simple one by closing the wound at once with a pad soaked in compound tincture of benzoin, which forms, with the blood oozing from the wound, a firm antiseptic covering. The limb may then be fixed on a back splint with a footpiece, and an ice-bag be applied over the joint. Should suppuration follow, the pad must be removed, free exit allowed for pus, and drainage be maintained till the discharge lessens or ceases. In more severe cases the surfaces of the wound should be carefully cleansed with carbolic lotion, any bleeding vessel should be secured by torsion or catgut ligature, tendons drawn out and ruptured should be cut short, and any loose pieces of bone be removed from the joint.

The wound having been placed in the most favourable conditions for recovery, and the dislocation reduced, the foot must be maintained upon a splint at a right angle to the leg; for should ankylosis take place with the foot in an extended position, the limb will be of little service. The splints usually employed are a wooden back splint and two side splints, interrupted opposite the ankle to allow the dressings to be applied. But, in the writer's opinion, a better splint is a simple iron one, such as he is in the habit of using for excision of the ankle. It consists of a thin iron plate, hollowed to receive the leg, and its continuation is looped under the heel (at such a distance as to allow the antiseptic dressings to be wrapped all round), and then carried up as a footpiece to support the sole. It is covered with wax lint, and, the limb being secured in it by means of waxed bandages, no change in position need be made for months, or until ankylosis is complete. The judgment of the surgeon having been given in the first instance in favour of an attempt to save the limb, subsequent sloughing, extensive suppuration followed by exhaustion, or secondary hæmorrhage may compel him to reconsider his opinion, and induce him to perform a secondary amputation in order to save his patient's life. R. Clement Lucas.

ANKLE, Excision of the.—*See* Joints, Excision of.

ANKLE-JOINT, Amputation at the. Various methods have been proposed for the performance of this operation—the circular incision; the long dorsal flap method (Baudens); lateral flaps; and the single internal lateral flap operation (Roux, Sédillot, Mackenzie). Owing, however, mainly to the delicacy and thinness of the flaps, and as a rule the unfavourable situation of the cicatrix, these procedures have failed to bear the test of experience, and have been altogether superseded by the mode suggested by Professor Syme in 1843. This operation is undoubtedly one of the most important of the many surgical procedures associated with the name of that surgeon. The results, as shown by statistics, leave no doubt as to its merit and comparative freedom from risk; and the writer is of opinion that the so-called improvements and modifications which have been proposed should be rejected.

Syme's Operation — one indicated, in the great majority of instances, in cases of tarsal caries—may be thus performed. Provision being made for the prevention of hæmorrhage, which can best be accomplished by Esmarch's elastic bandage, the patient should be placed on a table, with the condemned foot overhanging it. An assistant should then forcibly flex the foot upon the leg, and the operator, fixing the foot with his left hand, which he places behind the heel, and with his index finger and thumb on the points between which the incision should be made—viz., the tip of the outer malleolus and a point half an inch below and a little behind the inner malleolus—makes an incision with a small catlin, straight across the sole of the foot and down to the bone. Some surgeons recommend the incision to be sloped towards the heel, which diminishes the size of the plantar flap, and renders the operation easier, as there is not then so much tissue to dissect off the bone. In cases where there is much prominence of the heel, this modification may, in the writer's opinion, be adopted. Having made the incision across the sole of the foot, the flap is dissected off the inferior and lateral surfaces of the bone, great care being taken to keep as close to the bone as possible. This dissection had best be done with the knife recommended for the purpose by Professor Syme—a short, blunt-pointed, stout scalpel, with a strong, roughened handle. In using this knife there is but slight risk of making punctured wounds in the smaller vessels, the occurrence of which predisposes to sloughing of the flap. The dissection is continued backwards until the tendo Achillis is reached and divided.

A straight dorsal incision, at an angle of 45° to the sole of the foot and long axis of the leg, should then be made between the two points already indicated. If the incision be somewhat arched in front, as is done when the plantar incision has been carried farther back than Syme recommended, the danger of opening into the astragalo-scaphoid joint should be borne in mind, as such an accident may be a source of much embarrassment to an inexperienced operator. In the dorsal incision the structures in front of the ankle-joint are divided as well as the lateral ligaments, and the articulation exposed. Some surgeons prefer postponing the division of the tendo Achillis until this stage of the operation is reached, and much may be said in favour of doing so rather than at the termination of the dissection of the plantar flap, as recommended by Syme. The foot is then removed by disarticulation of the ankle-joint. The soft tissues over the malleoli are next dissected back, and these latter, together with a thin slice of the tibia, are removed, and the divided surfaces of the bones covered by the plantar flap. The bone section should be made at right angles to its axis. The anterior tibial artery in front, and the posterior tibial below the inner malleolus having been secured, the edges of the flaps should then be united with numerous points of interrupted suture, careful provision being made for drainage at each angle of the wound. For this purpose it has been proposed to make button-hole incisions in the flap, a procedure which is certainly to be deprecated.

In performing this amputation, it is undesirable to make the plantar incision from malleolus to malleolus, the evil results of such a course being to render the flap unnecessarily long and unsymmetrical, while increasing the difficulties of dissecting it off the bone, and thus imperilling its vitality. The writer has derived much aid in forming the plantar flap—the most tedious and difficult part of the operation—from the use of von Langenbeck's periosteal raspatory. An objection has been made to this plan on the ground that by leaving portions of periosteum in the flap, spicula of bone may be developed, which prove a source of trouble; but such osseous developments the writer has never satisfied himself of, and there is negative evidence to the contrary. In reference to the vitality of the flap, Erichsen does not consider the division of the posterior tibial artery an accident of serious moment, a view in which Lister and the late Professor Spence coincide.

Mackenzie's Modification, which is similar to that described by Roux, consists in making the flap from the antero-internal aspect of the joint, thereby including the posterior tibial artery, and thus diminishing, it is alleged, the risk of sloughing; but since it has been shown that a wound of that vessel is not so serious an accident as is generally supposed, this modification cannot be regarded as an improvement on the original. In fact, the flap, being one unaccustomed to pressure, is at an obvious disadvantage.

In Pirogoff's Osteo-Plastic Amputation, while the line of incision is the same as in Syme's, the essential difference is that the posterior portion of the os calcis is left in the flap, and subsequently united to the extremity of the tibia. Having made the plantar incision as in Syme's amputation, a straight one is made across the dorsum of the foot half an inch in front of the anterior tibial edge; the tendons and other structures in front, and at each side of, the ankle-joint, are divided, and the articulation opened into. The foot is then extended, and the os calcis divided obliquely downwards and forwards, with a saw following the line of the plantar incision. The soft tissues are then dissected off the malleoli, and these, with a slice of the tibia, removed. The cut surfaces of the bones are then applied closely together, and the edges of the wound united by numerous points of interrupted suture, a small drainage-tube being inserted at each angle.

The objections that have been made to Syme's amputation have been chiefly based on its difficulty and tediousness, the unnecessary shortening of the limb, combined with the risk, despite all precautions, of sloughing of the flap. Pirogoff's modification is undoubtedly a procedure of easier performance, getting rid, as it does, of the difficulty attending the dissection of the flap off the os calcis. Moreover, the stump obtained is longer than in Syme's amputation, the additional length corresponding to the amount of bone left in the flap, while the heel, long accustomed to bear the weight of the body, remains untouched. Possessing as it does these advantages, it may be asked, Why has not Pirogoff's modification superseded Syme's? The answer is that in the majority of cases of caries of the tarsus, the disease is seldom found localised, and the portion of bone left in the flap is liable to become affected, probably necessitating further operative measures, which may involve amputation of the leg. At the same time, if structures, previously healthy are dealt with, as, for example, in cases of gun-shot injury, Pirogoff's method may be selected.

Pirogoff's method has, in its turn, been the subject of much modification; for example, oblique division of the tibia upwards and backwards (Sédillot), with the view of diminishing the tension of the tendo Achillis. This has been properly objected to on the ground of its throwing the point of pressure behind the axis of the leg. Horizontal section of both os calcis and tibia (Pasquier); leaving the malleoli untouched, and placing the cut surface of the os calcis between them (Fergusson); concave section of the os calcis and convex of the tibia (Bruns), are, among others, modifications which have been made, but in which the writer fails to see any advantage. If the operator has any apprehension as to difficulties arising in keeping the cut surfaces of the bones together, tenotomy of the Achilles tendon, or suturing the bones with silver wire or chromicised catgut may be adopted. No other modification of the operation is indicated.

William Stokes.

ANKLE-JOINT, Diseases of the.—The ankle-joint, concerned as it is in transmitting the weight of the body to the foot, and also in the movements of active progression, is especially liable to sprains and concussions, and thus to the various inflammatory conditions to which such injuries give rise.

Synovitis, acute and chronic, is of frequent occurrence. The acute form is characterised by the usual symptoms, pain, heat, and swelling; the movements of the foot on the leg being restricted, and giving rise to increased pain. The swelling is manifest chiefly beneath, and at the sides of, the extensor tendons, but may also extend to the borders of the tendo Achillis.

The *treatment* will consist, in the early stage, of antiphlogistic measures, leeches, or the application of cold; subsequently, of counter-irritation, and the use of pressure by strapping and bandaging. The joint is to be kept at rest by placing the leg on a splint with a foot-piece, such as McIntyre's.

The chronic form of synovitis of the ankle may result from frequent sprains (the joint having once been sprained is liable to a recurrence of the injury because of the resulting relaxation of its ligaments), or, as is not uncommonly the case, may have its origin in an articular ostitis spreading to the joint. The scrofulous form of the disease more often affects several of the articulations of the foot; it may, however, be confined to the ankle, producing the usual pulpy swelling of the synovial tissue, and, if progressive, leading to ulceration of the cartilages and suppuration of the joint. Matter usually points at the side of the joint, and when this stage has been reached, crepitus will usually be felt on flexion and extension of the foot.

At the commencement of the disease counter-irritation by repeated small blisters, or by the actual cautery, must be used; followed by strapping over mercurial ointment, or by elastic pressure.

In most of the chronic forms of disease of the ankle, or other joints of the foot, the part may be kept at rest by means of a plaster of Paris, leather, or other splint, while the patient goes about with the aid of a peg-leg, which supports the weight of the body on the bent knee, the foot not being used.

The ankle is especially liable to a form of recurrent synovitis, due to the presence of intra-articular adhesions which have had their origin in a sprain or other injury. In such cases there is usually not much synovial effusion, though the amount varies with the use of the joint; but the patient is afraid to use the foot freely, movement in some particular direction being always restricted and painful. Attempts at greater activity being always followed by increased pain and swelling, the patient spends his time between alternations of enforced rest and painful endeavours at resuming activity. These cases are to be treated by forcible rupture of the adhesions, which usually produces an immediate cure. Anæsthesia being produced, the adhesions are ruptured by forcible flexion, after which the foot is freely moved in all directions. The patient is then to be encouraged to use the foot freely. *See* Bone-Setting.

Suppuration of the ankle-joint must be treated by free incision and drainage, and if there be pulpy degeneration of the synovial membrane, the diseased tissue must be scraped or destroyed with caustics.

Should the disease still progress, but yet remain confined to the ankle-joint, excision may be performed; but extension is very apt to occur to the neighbouring joints of the foot, in which case amputation will be needed, either by the method of Syme, or in the lower third of the leg.

J. Warrington Haward.

ANKYLOSIS.—By ankylosis is meant a joint stiff from changes in one or more parts of the articulation, in the synovial membrane and capsule, ligaments, or bones. The term implies that all active disease has ceased. Joints stiff from such causes as cicatricial contraction after burns, or diseases such as ossification of tendons, are said to be affected with spurious ankylosis, but such conditions will not be considered in the present article. Ankylosis, always the result of inflammatory action, may be, (1) soft or fibrous, (2) bony :—

(1). Ankylosis, due to changes external to the actual joint, but involving the parts immediately in relation with it, is one of the commonest forms. It is usually due to traumatic causes. The non-elastic capsule and synovial membrane being torn by the injury, probably associated also with tear of tendons at their insertions, a degree of inflammation is set up. Lymph is effused, and binds the folds of capsule together, or uniting the fibrous structures around the capsule limits mobility. Such adhesions, if neglected, develop ultimately into material more or less fibrous and tough. The inflammation may extend more widely, and the capsule and ligaments, at one time infiltrated and soft, will subsequently shrink and thus further impair mobility. Too prolonged rest, after even slight inflammation, will lead to considerable soft ankylosis, as may often be seen after dislocation of the shoulder. The changes in the cartilage in this form will be merely such as result from disuse.

(2). If the cartilages be involved, as commonly happens in pulpy degeneration of joints, granulation tissue, fibrous according to its age, will unite the opposite articulating surfaces. The disease may stop here, and the bands may even ultimately ossify, but this rarely happens. The cartilaginous tissue loses its characteristic qualities, becomes fibrillated, and degenerates more and more; even though the disease stops short here, with the changes in the parts around, firm fibrous ankylosis results. Commonly the disease extends through the cartilaginous laminæ and the calcified layer at their base, ultimately involving the bone. Now the opposed bony surfaces come into contact. The effused granulation-tissue, filling up the irregular erosions, forms into short, broad, fibrous bands, which firmly unite the opposed surfaces. In the course of time, usually to be measured by months, these bands may ossify; thus bony ankylosis is produced, necessarily associated with fibrous ankylosis around the joint. In the course of years the line separating the contiguous bones will almost disappear, and on section the cancelli will appear to pass uninteruptedly across. A still more complete bony ankylosis is seen as the result of osteo-arthritis. Here not only are the bones welded together, but the soft parts around undergo complete ossification. This condition usually affects more than one joint. It is most frequently seen in the small joints, such as those of the phalanges or tarsus.

Soft ankylosis will always permit of some amount of movement. If moving the joint, i.e. stretching the adhesions, causes pain, we may judge that the ankylosis is soft; but it may be readily mistaken for that which is bony unless examination is also made under complete anæsthesia. It is very common to mistake a joint held stiff by contracting muscles for one which is really ankylosed. No satisfactory diagnosis, where there is any considerable degree of ankylosis, can be made without the aid of anæsthetics. A greater or lesser degree of ankylosis usually follows a compound dislocation, and the closer the normal apposition of the articulating surfaces the more likely is the union to be bony, e.g. compound dislocation of the elbow or ankle is more liable to terminate in bony union than that of the knee, and spinal caries often results in complete fusion of two or more vertebræ.

Pulpy degeneration of joints, especially of the knee, is apt, after more or less destruction of the cartilages, as the process of natural recovery, to progress slowly to bony ankylosis. In the hip-joint, however, this result is far less common.

The *symptoms* of ankylosis consist of impairment or loss of mobility; pain on manipulation if the soft ankylosis is moderately recent, complete loss of movement under anæsthesia if the ankylosis is bony. The commoner form of ankylosis is the soft, arising from some injury, the most usual being dislocation. A few bands external to the actual joint glue the folds of the capsule together, but every movement causes pain, and consequently rest is persevered in too long; or, as in the case of the shoulder-joint, the movement of the scapula on the trunk is mistaken for movement of the humerus on the scapula. Degenerative changes follow as they would in a perfectly healthy joint kept absolutely at rest. The synovia ceases to be secreted, the vascularity of the membrane diminishes; the cartilage tends more and more to resemble connective tissue; the bone becomes porous, light, and thin. Still, all this can be recovered from if the adhesions be broken through. The folds will again separate, and with the restoration of mobility the structures of the joint will rapidly recover.

Treatment.—It is of the utmost importance to break down, and not merely to stretch, the adhesions; their situation can be ascertained by localising the pain felt on manipulation without an anæsthetic—that is, by stretching. Bearing in mind the anatomy of the joint and the normal movements of which it is capable, a sharp, decided movement should be made, and the adhesion will break with an audible snap—one form of 'bone-setting.' This treatment is especially applicable to ankylosis from traumatic causes, and to those who are pathologically young. Scarcely any inflammation follows if the adhesions be really broken through; the process, if efficiently performed, is more alarming than painful, and the after-treatment consists merely in passive and active movements to prevent the adhesions from re-forming, with shampooing and douching. In slight, soft ankylosis of the shoulder, the wrist, the knee, and phalangeal joints, the result will be successful in inverse ratio to the extent of the adhesions and the length of time that has elapsed since the inflammatory action. The latter can be estimated better by the history than by the amount of wasting of the muscles, for this is often very rapid, especially in cases of ankylosis of the shoulder in elderly people.

In ankylosis from disease, the relation of important vessels and nerve-trunks to the joint, and the possibility of their being adherent to the capsule, must be borne in mind, particularly in such as are likely to be the subjects of atheromatous changes. Especially should this be remembered in the case of the hip and knee, in both of which joints undue extension might lead to serious consequences. In the elbow it is very rare to restore perfect mobility, even after slight ankylosis. In soft ankylosis of the hip in young children, gradual extension, to be applied at the outset in the new axis of the limb, is preferable to attempts to rupture the adhesions. Violent movements are very liable to awaken the hip-joint disease in delicate subjects, and some amount of ankylosis with the limb almost in a straight position is often the best result that can be obtained. The same is true of the knee-joint, if there is backward displacement of the bones of the leg. Soft ankylosis of the knee, with the leg strongly flexed on the thigh, is a common result of neglected inflammation of the joint. Here, gradual extension cannot be so well employed. Under an anæsthetic the limb can be forcibly straightened, the adhesions being often better broken by strong flexion rather than by extension. The limb can thus be placed in a useful position, even though some degree of backward displacement results.

The results of tenotomy in the treatment of ankylosis are, as a rule, rather disappointing in cases of hip and knee ankylosis; but, as a preliminary to gradual mechanical extension, it is often beneficial. In division of the hamstrings no attempts should be made to divide more than the contracted tendons. Treatment by gradual extension, then, is applicable to those cases where the ankylosis is fibrous and the object is not so much to attempt the restoration of mobility as to place the limb in a useful position. It is especially applicable, therefore, to the hip and knee when the amount of organic change suspected forbids the employment of violent extension; but even where the adherent and contracted parts have been forcibly ruptured, no attempt should be made to place the limb at once and fix it in the position it is hoped ultimately to obtain. The forcible extension should be regarded only as a preliminary to treatment by gradual extension. The weight and pulley will be found to answer better than the more complicated and expensive apparatus.

Bony Ankylosis, when the parts are in good position, should be left alone. An exception may be made in the case of the temporo-maxillary joint, in which, however, disease is very rare. Here, by osteotomy of the ramus of the jaw, a false joint may be established with advantage, and the joint itself has been excised with a good result. Bony ankylosis of the shoulder is exceedingly rare, and admits of no treatment. Increased mobility of the scapula makes very adequate amends for the stiffness of the joint. In the elbow complete mobility may be restored by excision, but only when the patient earnestly desires it and fully appreciates the conditions; an elbow ankylosed at about a right angle impairs but little the utility of the arm. In the case of the wrist no operative interference is admissible. In the phalanges amputation may be necessary to get rid of a deformed finger or toe. In the case of the great toe excision can often be performed with advantage. Bony ankylosis of the hip may demand treatment if the deformity be great. Examination under full anæsthesia is, in this case, imperative, and care must be taken not to mistake the production of lordosis for movement at the hip. The less the destruction of the internal parts of the joint, the more favourable the case for treatment. Cases of osteo-arthritis are the most favourable of all. Subcutaneous osteotomy of the neck of the femur (q.v.), by Adams's or Sayers' method, is the best treatment. The results of the operation in suitable cases are very satisfactory. The bone may be divided also below the trochanters, but this is not so favourable an operation, though sometimes the only one that offers. Complete bony ankylosis of the knee in a faulty position may require osteotomy. The results of Macewen's operation for genu valgum show the amount of deformity that can be rectified by simple osteotomy, and it will probably not often be found necessary—as many advise—to remove a wedge-shaped piece of bone. If done, this should be so performed as to preserve the epiphysial line. Attempts to perform the operation subcutaneously in the case of the knee are not to be recommended. Bony ankylosis of the vertebral joints admits of no treatment, save, perhaps, in the case of the sacro-coccygeal joint. *See* Bone-Setting; Jaws, Closure of the; Osteotomy.

C. T. Dent.

ANOREXIA.—Loss of appetite.

ANOSMIA.—Loss of the sense of smell.

ANTERO-POSTERIOR SPINAL CURVATURE (not due to spinal caries or hip-joint disease) is an exaggeration of the normal antero-posterior curves of the spinal column. If the dorsal curve with convexity backwards is most marked, the deformity is known as *cyphosis* (kyphosis); and when the lumbar curve with convexity forwards is predominant, it is known as *lordosis* (saddle-back). Cyphosis and lordosis are generally present in the same patient, the one compensating the other in restoring the equilibrium of the body. Lateral curvature of the spine is nearly always accompanied by some amount of antero-posterior curvature. *See* Lateral Spinal Curvature. Cyphosis, embracing the whole spine from the neck to the sacrum, is not infrequently met with, where all lumbar hollow has disappeared; but lordosis is always associated with some degree of cyphosis.

The *causes* and *pathology* are the same as in lateral curvature, except that antero-posterior curvature is more often due to paralysis of the erectores spinæ muscles, as in infantile paralysis; lordosis is nearly always present in marked cases of pseudo-hypertrophic paralysis, when the patient is standing.

At first complete restoration to the normal figure of the spine is possible. In cyphosis, after the lapse of months or years, the bodies of the vertebræ and the intervertebral substances become misshapen, and too much wedge-shaped from before backwards, so that at last they become so fixed or ankylosed that all attempts to restore the spine to a normal, or even improved, position end in failure. It is always easier to restore or improve the position of the spine in lordosis, where there is much less tendency to deformation and ankylosis of the vertebræ.

Symptoms.—The patient generally complains of much backache and neuralgia from irritation of the spinal nerves. The thorax becomes contracted and flattened anteriorly, or is often pigeon-breasted. The scapulæ are too far apart, and their lower angles too projecting. The abdomen is too prominent, and the patient walks with a slight waddling gait. His powers of endurance are affected, and he is easily tired; his general health fails, and congestive headaches are frequent.

The *diagnosis* presents little difficulty. Lordosis cannot be mistaken for anything else. Cyphosis can only be confounded with spinal caries. When the cyphosis is of recent origin, all deformity and unnatural projection of the spine disappear when the patient lies prone on the ground; even in severer cases, where the deformity persists in the prone position, the erectores spinæ muscles feel as soft and normal opposite the chief prominence of the convexity as at any other point of the spine; whereas, in spinal caries, the same muscles opposite the seat of the greatest projection give a more unyielding sensation to the touch, and are apparently enlarged, as compared elsewhere along the spine. This softness of the erectores spinæ muscles, with little or no pain on violently concussing the heels while standing, and with the presence of some slight movement of flexion or lateral flexion even in very severe cases, will confirm the diagnosis of cyphosis from spinal caries.

Prognosis.—The tendency of antero-posterior curvature, especially of cyphosis, is to become gradually worse if left untreated, so that the patient becomes prematurely bowed down to the ground, as in old age.

Treatment.—In lordosis and in cyphosis, where the spine is still movable, the same treatment is advised as in lateral curvature, viz. medical gymnastic exercises, with attention to good postures at all times. No article of clothing is to be too tight across the front of the thorax or neck, when the patient is placed in the most improved position possible.

In lordosis, exercises effecting thorough flexion of the spine, e.g., sitting on the ground with the knees extended, and the patient touching the toes without bending the knees, or the same while he is standing, are very useful in addition.

In cyphosis, where the spine is partially ankylosed, and where there is much pain or aching in the back, relief may be obtained by the wearing of a well-applied plaster of Paris jacket, cut open in front, and made to lace; or a poro-plastic or other support with pelvic band, which will probably have to be worn for several years, till the ankylosis has become so complete as to admit of the patient going about without any support at all, free from pain or discomfort. No treatment is required in cases of ankylosed cyphosis unaccompanied by pain or aching.

Bernard Roth.

ANTHRAX. *See* Carbuncle.

ANTISEPTIC SURGERY.—By the term 'antiseptic surgery' is meant those modes of treating wounds in which an attempt is made to prevent fermentation in the fluids of the wound; thus applied, the term includes a variety of methods, and the use of a large number of antiseptics.

The original aim of antiseptic treatment was to prevent putrefaction, and the freedom of the discharge from foul smell was looked on as proof that the object of the treatment had been attained, and that the patient was safe from the risks usually associated with, and at that time supposed to be dependent on, a putrid state of the discharge. As experience increased, it was, however, soon found that, in spite of absence of smell from the discharge, the patient was by no means safe from many of the accidents at first supposed to be closely connected with putrefaction, such as suppuration, erysipelas, septicæmia, and pyæmia. The rapid advance of science in this department has now shown that many of these infective diseases are due to the growth of specific micro-organisms in the fluids or tissues of the patient affected; and has further taught us that none of these organisms produce putrefaction in organic fluids. It is thus evident that absence of smell is no test of the absence of these septic agents from wounds; for, on the one hand, the micro-organisms which cause putrefaction may have been excluded from the wound, or prevented from developing, while, on the other hand, the real septic agents may be present in an active state.

But investigations have taught us that the growth of micro-organisms in an organic material is accompanied by changes in that material, the nature of these changes depending on the variety of bacterium which is there developing; in fact, as the result of the growth of these minute bodies, the organic matter undergoes fermentation. These considerations have led the writer to enlarge the definition of antiseptic treatment from 'treatment directed against the causes of putrefaction' to 'treatment directed against the causes of fermentation'—in other words, against the development of micro-organisms in wounds. It is not necessary in the present article to enter into the reasons for regarding micro-organisms as the causes of fermentations, nor into the mode in which they act; that they are the causes of the fermentative changes which organic material undergoes has been thoroughly debated, and may now be regarded as settled. *See* BACTERIUM.

It must not, however, be supposed that it is only by causing fermentation in the wound that these micro-organisms are dangerous. Some, no doubt, can only grow in the discharges or dead tissues in a wound, and are unable to penetrate into and live in the body; but nevertheless these may lead to the formation of poisonous products in the wound, which, being absorbed, give rise to more or less serious symptoms, and even to death (traumatic fever, septic intoxication, and some forms of septicæmia), while their local effect may be evidenced by inflammation, suppuration, &c. Others, however, can penetrate directly into the tissues, lymphatic vessels, and blood, and, growing there, give rise to most serious affections, (spreading gangrene, erysipelas, pyæmia, &c.) It has, however, been found that means, sufficient to prevent the growth of micro-organisms and the occurrence of fermentation in wounds, are also sufficient to prevent the entrance of these parasites into the body. If, therefore, the point aimed at in the definition be successfully reached, all that is required for antiseptic treatment will be obtained.

It is of importance to note that bacteria are not normally present in the blood or tissues in the healthy living body. This has been demonstrated as regards blood, milk, urine, and various of the internal organs, by experiments which need not be referred to here. It is also found that, with very rare exceptions, the various septic diseases follow wounds—that the bacteria are, in fact, introduced into the body through a wound. In the treatment of a case after operation it is therefore most important, with the view of preventing septic diseases, to direct our special attention to the treatment of the wound, in order to prevent the entrance of the noxious organisms into the body.

There are two modes in which attempts have been made to carry out the principles described above. In the one, various precautions are taken with the view of preventing the entrance of micro-organisms into the wound; in the other, micro-organisms are admitted, and then means are taken to prevent or interfere with their growth and fermentative action.

The first principle is that introduced by Sir Joseph Lister, and his method was at first known as the antiseptic method, though the writer thinks it better to call it the aseptic method, in contradistinction to the second class of methods, which are also all more or less antiseptic. This is the method with which we have to do in the present article.

The second principle may be carried out in various ways, which will be considered separately, though, as a matter of fact, in practice the two are frequently combined.

(*a*) Various antiseptics are added to the discharge, either in the wound, by injection, &c., or after it has left the wound, with the view of rendering it an unfit soil for the development of micro-organisms—*treatment by antiseptics.*

(*b*) Means are taken to allow the discharge to flow away as rapidly as it forms, so that it has not time to undergo fermentation to any extent in the wound—*free drainage.*

(*c*) The discharge may be washed away either by water alone or by water containing antiseptics—*treatment by irrigation and immersion.*

(*d*) The wound may be freely exposed to the air, so as to allow evaporation to take place. In this way the discharge becomes too concentrated to permit the growth of bacteria in it, and at the same time the organisms being supplied with plenty of oxygen, their fermentative action is diminished—*open treatment.* In this method means are as a rule taken to permit the rapid exit of discharge, and also very frequently the wound is washed out with an antiseptic lotion, so that as a matter of practice all the four principles just alluded to are brought into play.

(*e*) If the parts are kept at perfect rest, the health of the patient good, and not too much blood between the opposed surfaces, healing may occur without inflammation or suppuration. Here trust is placed in the power of the healthy tissues to destroy bacteria. Acting on the last two principles we have *healing by scabbing.*

For the description of the methods of wound treatment mentioned under the second heading, the reader is referred to the special articles on the subject; here we have only to do with the first principle.

In the Listerian method the object is to prevent the entrance of living organisms into the wound, and with this view a large number of precautions are taken, which will be given in detail in the latter part of this article.

A wound treated aseptically, provided that micro-organisms are excluded, that the drainage is good, the stitches not too tight, and no other local cause of inflammation is present, follows what is termed an 'aseptic course.' No inflammation occurs; there is no swelling nor redness of the edges of the wound, the skin around remaining as pale and lax as when it was stitched up at the time of the operation. The wounds are thus quite painless; but not only is there absence of inflammation along the cut edges of the skin, it is also absent from the deeper parts of the wound, and there is no suppuration even where the deep structures are not absolutely in contact. The discharge from the drainage-tube is purely serous, and rapidly diminishes in amount, so as to render the drain unnecessary in a very short time. Further, the scar is linear, and very soon becomes hardly apparent, while it remains movable, and does not become adherent to the deeper structures.

While there is this absence of local disturbance in wounds treated aseptically, the constitutional state of the patient remains good; in fact, if he has not lost much blood during the operation, or if the operation has not caused shock, he is, on recovery from the effects of the anæsthetic, practically as well as before. His appetite is good, and there is no necessity for restricting his diet; at the same time traumatic fever is absent. After an operation performed aseptically, and in which there is no accidental cause of elevation of temperature, such as tension, the temperature remains normal; or if the operation is at all extensive, the following changes are observed. On the evening of the operation the temperature falls below the normal, it then rapidly rises to, or it may be a little above, 100°, reaching its highest point on the following morning or evening, and then it rapidly falls to the normal line again. In some cases, before reaching the normal, it fluctuates for a day or two between 99° and 100°, but the fluctuation is not within the range of fever temperature, but within the normal range. It is very seldom that the pulse rises in equal proportion; indeed it generally remains normal.

Interference with this typical course may be due to various causes, but it is generally occasioned by the entrance of micro-organisms. If micro-organisms have entered, there is no certainty as to the result; suppuration and traumatic fever will almost certainly occur, while any of the traumatic infective diseases—erysipelas, septicæmia, pyæmia, &c.—may appear. Of the disturbing causes not due to micro-organisms, tension in the wound from retention of discharge, or from tight stitches, is the most potent. The elevation of temperature, which follows the retention of discharges in a wound, is often very striking, and the reason of its occurrence is not very clear. At the same time the local effect is to give rise to pain and inflammation in the wound, which, if not checked by restoration of the drainage, may go on to suppuration. This disturbance is easily remedied by proper application of a drainage-tube. If, in spite of thoroughly efficient drainage, the inflammation still goes on, the cause is evidently the entrance of micro-organisms. Tight stitches also cause inflammation of the edges of the wound, which subsides as soon as the stitches are cut or removed, and movement of the parts will also interfere with the aseptic course. The irritation of the antiseptic employed may also interfere with healing, if it is allowed to come directly into contact with the wound. It is for the purpose of excluding the antiseptic from direct contact with the wound, that the layer of prepared oiled silk is applied beneath the dressing.

Carbolic Acid.—Various antiseptics are employed in aseptic surgery. The first which was introduced, and still in many respects the best, was carbolic acid. This is employed in the form of lotions, oily and spirituous solutions, and gauze dressing. The carbolic lotions are of two strengths, 2½ p.c. and 5 p.c. These are watery solutions of the pure acid, and they ought to be quite clear. If they are not clear, the reason is the presence of impurities in the carbolic acid, which are apt to be very irritating to the wound and to the skin. The 5 p.c. lotion is used for disinfection of the skin, instruments, and hands of the operator and assistants, and also for the spray. The 2½ p.c. is the lotion used for washing the sponges and for cleansing the wound afterwards.

Carbolic oil is employed of various strengths, generally 1 in 5, 1 in 10, and 1 in 20, consisting of carbolic acid mixed with olive oil in the foregoing proportions. The 1–5 oil is seldom used, though it is occasionally applied as a dressing to very foul wounds. The 1–10 oil is used as a dressing for wounds in the neighbourhood of the anus, penis, &c. Carbolic oil (1–20) is used for oiling catheters or other instruments before introducing them into the bladder. In many cases, glycerine solutions of carbolic acid are now employed in place of the oily.

A solution of carbolic acid in methylated spirit (1–5) is also sometimes employed for injection into compound fractures or wounded joints, where the injury has happened some hours before the case is seen.

Carbolised gauze is the material generally employed as a dressing to guard against the entrance of the causes of fermentation. This is ordinary fine unbleached tarlatan, impregnated in various ways with one part of crystallised carbolic acid, four parts of common resin, and four parts of paraffin. These materials, mixed together, are added to an equal weight of unprepared gauze. The gauze ought to be kept in a tin box, closing tightly, to prevent evaporation of the carbolic acid. It is used either in the form of folded dressings, loose gauze, or bandages. The dressing consists of a piece of gauze of sufficient size to overlap a considerable area of skin around the wound; this is folded in eight layers, and beneath the outer layer a piece of macintosh cloth is placed, with the rubber side downwards. This macintosh ought to be sponged with 1–20 carbolic lotion before being placed in the dressing.

The steam spray-producer is ordinarily used. In the glass vessel 1–20 carbolic lotion is placed, and this, mixed with the steam, is diluted to about 1–30.

Carbolised silk is often used for sutures, and is made by steeping silk thread in a mixture of nine parts of beeswax and one part of carbolic acid, melted together. As the thread is taken out of the mixture it is drawn through a cloth to remove the superfluous wax.

Carbolised catgut, made by immersing catgut in carbolic oil, was formerly used for ligatures and sometimes for stitches; but lately a new catgut has been employed, made with a watery solution of chromic and carbolic or sulphurous acids. This new catgut is kept dry, and an hour or two before use it is immersed in 1–20 carbolic lotion.

Sponges are washed after an operation, and are then kept soaking in a jar containing carbolic lotion 1–20. During an operation they are washed in 1–40 carbolic acid lotion.

Salicylic Acid.—Various substitutes are employed in aseptic work, one of the best being salicylic acid. This is used chiefly in the form of lotion, and wool or jute. The lotion is a saturated watery solution, and contains about 1 part of the acid in 300 parts of water. This is only used for washing wounds; carbolic acid is employed for the disinfection of the hands and instruments, for the spray and for washing the sponges.

Salicylic wool or jute are cotton wool or jute containing salicylic acid, and two different strengths are employed, the material having 3 or 10 p.c. by weight of salicylic acid. Glycerine is generally added to the solution in order to make the crystals stick better to the wool. In applying the dressing, a piece of perforated guttapercha tissue, covered by carbolic gauze, is placed next the wound; over this comes one finger's thickness of the strong wool or jute, and then two fingers' thickness of the weak wool. No macintosh is required. In some cases where inflammation is present, this dressing is kept wet with the salicylic acid lotion.

Salicylic acid is also sometimes used as a powder mixed with other substances, such as starch, zinc oxide, &c. The wound is dusted with the powder with the view of forming a crust, and healing is thus obtained by scabbing. This method is really only of use in small wounds. The objections to its use in large wounds are that the pain is great, the material expensive, and there is very apt to be confinement of the discharge.

A salicylic ointment is used for superficial wounds, and is made in the following manner:—Make a basis of two parts of paraffin to one part of vaseline. Take of this twenty-nine parts, and of powdered salicylic acid one part. Salicylic acid cream, made by mixing salicylic acid crystals with glycerine to the consistence of cream, is very useful for application around a wound where a dressing is to be left on for some days. It prevents and diminishes the eczema which sometimes occurs under these circumstances.

Acetate of alumina is apparently a very good antiseptic, and is used by Maas and others in place of carbolic acid. The lotion is a watery solution of the strength of $2\frac{1}{2}$ p.c. The strength of the spray is also $2\frac{1}{2}$ p.c. A piece of protective, dipped in this solution, is applied next the wound, and covered with lint soaked in the solution. Outside the lint comes a piece of macintosh, and the edges of the dressing are surrounded by salicylic wool.

Eucalyptus oil is a powerful antiseptic which is useful sometimes as a substitute for carbolic acid. It is chiefly employed in the dressing, the gauze being made with eucalyptus oil instead of with carbolic acid. It is not so poisonous nor so irritating as carbolic acid, and is therefore applied in cases where carbolic acid cannot be borne, but it is not so trustworthy as an antiseptic.

Bichloride of mercury is coming very much into fashion of late, and it may perhaps ultimately replace carbolic acid, but as yet there are several grave objections which must be overcome. Max Schede employs two solutions: a weak, watery solution of $\frac{1}{50}$th p.c. strength, and a strong watery solution of $\frac{1}{10}$th p.c. These are used for disinfecting the skin, and as lotions for the wound, &c. For the spray and the disinfection of instruments, carbolic acid is still employed. A sublimate dressing is used, made by soaking gauze or wool in the following solution: corrosive sublimate 10 parts, glycerine 500 parts, and alcohol 4,490 parts. Von Bruns employs wood wool impregnated with $\frac{1}{2}$ p.c. sublimate and 5 p.c. glycerine. Sir Joseph Lister suggests a solution in serum for making the gauze, thinking that the combination with serum diminishes the irritation caused by the sublimate. As yet the best mode of employing it is only being worked out.

Napthalin, thymol, iodoform, and various other substances are also employed.

When a wound becomes quite superficial, various preparations of boracic acid may be used with advantage.

Boracic lotion is a cold, saturated solution of boracic acid in water. Boracic lint is ordinary surgical lint soaked in a hot saturated solution of boracic acid, and then hung up to dry. Boracic ointment of various strengths is also used. The full strength ointment contains, of the same basis as previously mentioned for salicylic ointment, 5 parts, and of boracic acid crystals 1 part. Boracic ointment may also be used of $\frac{1}{2}$ or $\frac{1}{4}$ the above strength.

For the purpose of purifying sinuses, ulcers, &c., a solution of *chloride of zinc*—40 grs. to the ounce of water—is employed. Care must be taken in injecting this solution into a wound that free exit is allowed, otherwise it may pass into the tissues and cause gangrene.

An Aseptic Operation.—To illustrate the best method of using these antiseptics, let us consider, in detail, the precautions necessary when carbolic acid is employed. It may be convenient, in the first place, to give a list of the various things required:—

Carbolic lotions, 1–20 and 1–40.

Sponges which have been kept soaking in 1–20 carbolic lotion and are washed in the 1–40 lotion during the operation.

A large, flat dish in which instruments can be laid and covered with a layer of 1–20 carbolic lotion.

Small dish, containing 1–20 carbolic lotion, to purify the skin of the patient.

Small dish, containing 1–40 carbolic lotion, in which hands and instruments can be repurified during the operation.

Small dish, containing 1–40 carbolic lotion, in which a piece of protective oiled silk and a piece of carbolic gauze are placed to soak. It ought also to contain a large piece of thin muslin, called a guard, to throw over the wound should the spray stop.

A steam spray-producer, containing 1–20 carbolic lotion in the glass vessel.

Towels soaked in 1–20 carbolic lotion.

Catgut steeping in 1–20 carbolic lotion.

Drainage-tubes, horsehair, and silkworm gut, in 1–20 carbolic lotion.

Stitches, silver wire, carbolised silk, catgut, horsehair, &c., in 1–20 carbolic lotion.

Protective (oiled silk coated with copal varnish and a layer of dextrine), in 1-40 carbolic lotion.

Carbolic gauze kept in a tin box till required.

A gauze dressing containing macintosh cloth, made as already described.

Bandages, of gauze or calico.

Narrow elastic bandage.

Safety pins.

Before beginning the operation, blankets and clothes are covered with pieces of macintosh cloth, outside which the soaked towels are arranged so that instruments, sponges, &c., may be laid down without being contaminated. The skin, in the neighbourhood of the seat of operation, is then thoroughly washed with 1–20 carbolic acid, though this is generally done, in hospitals, an hour or two before the operation. In any case the skin ought to be thoroughly washed with the lotion immediately before commencing the operation. This purification is absolutely essential, because the skin is covered with dust containing bacteria, which also, apparently, are abundant about the hairs, and they, possibly, also pass into the follicles. These must be destroyed, or rendered incapable of development, otherwise they would spread into the wound, and render the other precautions useless. This purification of the skin is carried out by washing it well with 1–20 carbolic lotion, the antiseptic being allowed to act for some time. It is well also, having first washed the neighbourhood thoroughly, to apply, over the seat of operation, a large cloth or towel soaked in the 1–20 solution and to allow this to remain on the part an hour, or longer if possible. The part ought also to be shaved thoroughly, especially the head, where a sufficiently large area of hair should be removed to allow satisfactory overlapping of the dressing.

The purification of the hands of the operator and his assistants ought also to be thoroughly done, special attention being paid to the nails and the folds of skin about the nails. This is best done with 1–20 carbolic lotion, though, in some cases, 1–40 is sufficient, and not only the fingers, but the whole hand, should be washed.

The instruments are purified by immersion in 1–20 carbolic lotion before the operation. A tin or porcelain trough, filled with the 1–20 solution, is employed for this purpose, the instruments being placed in it some time before the operation. They are not merely dipped; they must remain in the lotion for some time, because the carbolic acid requires a little time to act on the grease or dirt on them. The teeth of toothed instruments ought also to be cleaned thoroughly, and forceps locking by catches ought to be widely opened, so as to allow the solution to come in contact with every part. The whole instrument must be immersed, for if only the point be purified, it may happen that the impure handle is inadvertently brought into contact with the wound during the course of the operation.

The spray is useful in many ways. Whether it instantly kills all the bacteria floating in the air is certainly open to question, but it constantly bedews the surface of the wound with carbolic lotion, so that if living organisms do fall in, the action is continued, while it will hinder their development if they should not be killed. It also keeps the hands and instruments constantly moist with the lotion. Fortunately there are not many bacteria floating about in air, unless the dust has been disturbed by sweeping, &c., which, of course, ought never to be done immediately before an operation or the changing of a dressing.

The arteries are ligatured with catgut. There are three different sizes, the finest being that ordinarily employed for the smaller vessels. All ligatures are cut short.

Drainage may be carried out by means of tubes, or by capillarity—best by tubes. India-rubber tubes are employed with holes cut in them at short intervals. They are inserted to the deepest part of the wound, care being taken to use a sufficient number to drain all the recesses. At the outer end they are cut flush with the surface of the skin, because, if they project, they may be compressed and rendered inefficient. To keep the tube from slipping in, two threads of carbolised silk are fastened into it at its orifice and tied in a knot. This knot, held between the dressing and the skin, retains the tube in position. It is not essential that the orifice of the tube should be at the most dependent part of the wound, because the fluid, as it forms, wells out, and, not being putrid, that which lies at the bottom of the tube does not cause irritation. In cases where the most dependent opening would be near sources of putrefaction, it is well to have the drainage-tube in another part of the wound, even though it be not so dependent. Thus, in inguinal hernia the tube would, no doubt, be in the most dependent part if its orifice were close to the pubes, but as that would be too near to sources of putrefaction, such as the vagina and penis, the orifice of the tube ought to be at the outer angle of the wound.

Absorbable tubes are also sometimes employed, made of decalcified bone. The bone is decalcified, drilled, and soaked in carbolic and chromic acids. These tubes do not require removal; they disappear, by absorption, in a few days.

Drainage by capillarity is carried out by catgut or horsehair. These drains are only applicable to wounds, they are not suitable for abscesses.

The accurate stitching of the edges of the wound is another feature in aseptic surgery. In operating aseptically, the same care need not be taken to remove as little skin as possible as is necessary in wounds treated by other methods, where swelling and inflammation of the edges are expected.

One may take away a wide sweep of skin, such as would seem to render hopeless any attempt to bring the edges of the wound into apposition, and yet if the edges can only be opposed, and if the wound remains aseptic, union by first intention may be expected along the whole line. Three kinds of stitches are employed. The first are the so-called 'button stitches.' These are flat pieces of lead with a hole in the middle. They are applied, at some distance, on each side of the edge of the wound, and connected by strong silver wire drawn tight enough to permit the edges of the wound to come easily together. Then silver wire stitches are inserted, taking a good hold of the tissue, termed 'stitches of relaxation,' and, in the intervals between these, numerous 'stitches of coaptation,' consisting of carbolised silk, horsehair, or catgut are introduced, in order to bring the cutaneous margins accurately together. If the silver stitches are found, in a few days, to be too tight, they can be cut, but there ought to be no hurry in removing the stitches unless they are positively doing harm.

The wound having been stitched, and efficient drainage secured, the dressing is now applied. In order to protect the margin of the wound from the irritation of the antiseptic, a piece of protective is interposed between the gauze and the wound. The protective is cut a little larger than the wound, but care must be taken not to put on too large a piece. There is nothing antiseptic in its substance, and it protects the discharge beneath it from the action of the carbolic acid; therefore, if at any part it projects beyond or comes close to the edge of the dressing, it allows the causes of putrefaction to spread inwards beneath it, and prevents the carbolic acid from acting on this putrefying discharge. This protective is dipped in 1–40 carbolic lotion before being applied.

Outside the protective a piece of gauze, wet in the 1–40 carbolic lotion, is placed, overlapping the protective in all directions. If the gauze is not wet, particles of living dust might be applied directly to the wound.

The protective and wet gauze constitute the 'deep dressing.' This may often be left undisturbed for several days, only the superficial dressing being changed. In this way the wound is not irritated by the application of carbolic acid to it every time the dressing is changed. This deep dressing must be treated as a wound, being itself covered with gauze soaked in the lotion. If the deep dressing is to be left on for any length of time it is well to rub some salicylic cream around the wound.

The gauze dressing should overlap the wound to a considerable extent in all directions. It is fixed on by a gauze or calico bandage. During the movements of the patient, the edge of the dressing might become separated from the skin, and air pass into the space thus formed. To prevent this, a piece of narrow elastic bandage is applied round the edge of the dressing, its general arrangement varying, of course, with the situation.

The next point is the changing of the dressing. It is only in very rare cases that it is necessary to change it the same evening. The only cases in which this is usually done are large empyemata or very large abscesses, and cases of amputation at the hip-joint, where the discharge of bloody serum is profuse, and where there is but little space for overlapping of the dressing.

As a rule, the dressing ought to be changed entirely the day after the operation, the deep part as well as the superficial. The dressing is changed under the spray, all the precautions as to disinfection of hands and instruments being taken. In removing the dressing, care must be taken that the edge next the spray is first raised, so that the spray passes into the angle between the dressing and the skin. The condition of the stitches and the drainage-tubes are attended to; a new dressing is then applied in the same way as before described. In future, the dressing is changed whenever discharge is found to have come through at the visiting hour; if there is no discharge through, and no other reason exists for changing the dressing, it is left till next day at visit, and then the same rule is followed. A dressing is never left longer than a week unchanged.

When the wound becomes quite superficial, boracic dressings may be used. The wound is washed with boracic lotion, a piece of protective dipped in the lotion is applied, and outside this one or more layers of boracic lint, overlapping the protective well in all directions. This dressing is changed every two or three days.

Boracic dressing is also very useful for ulcers. Where these are septic, the solution of chloride of zinc—40 grs. to the ounce of water—is thoroughly applied to the surface, and the skin around is washed with 1–20 carbolic lotion. In place of the chloride of zinc solution iodoform is sometimes used. In any case the boracic dressing is afterwards employed. The chloride of zinc or iodoform, as a rule, requires only to be applied once, but should putrefaction not be eradicated the application is repeated. In some cases boracic or salicylic ointments are preferable to the protective, especially where there is any cavity, or where the patient dresses the ulcer himself. Outside the ointment comes the boracic lint. Where much inflammation is present, the boracic lint may be used as water dressing, the wet boracic lint being covered with a piece of macintosh.

Treatment of Abscesses.—One of the most important points is the position of the opening. The ordinary rule is, as formerly, that the most dependent point should be selected, but there are many cases in which this rule ought not to be followed. The discharge which flows from an abscess-cavity after the first pus is evacuated is, under aseptic treatment, purely serous in character, and apparently unirritating. There is, therefore, no harm done if it is left to well out, so long as there is no hindrance to its exit. On the other hand, if an abscess be pointing, say close to the anus, and is opened where it points, micro-organisms are very likely to get in, and if this occurs, the course of the abscess may be altogether different; the cavity will suppurate, and healing be delayed, or burrowing of pus may occur, and sinuses remain open for a very long time. It is thus of much more importance to avoid putrefaction than to provide a dependent opening. A psoas abscess, for example, pointing at the upper and inner part of the thigh, ought not to be opened where it points, but above Poupart's ligament in the neighbourhood of the anterior superior spine, or, better still, in the loin. Again, retro-pharyngeal abscess is best opened by an incision at the upper and posterior border of the sterno-mastoid, a canal being burrowed in front of the vertebræ to the abscess. This has been done with complete success both by Professor Chiene, of Edinburgh, and by the writer. Again, in hip-joint abscess pointing near the perineum, an incision should be made in the healthy tissues lower down the thigh, and a canal burrowed to the abscess, The great rule, then, in opening abscesses is to make the incision as far as possible from sources of putrefaction.

When an abscess is opened, instead of dealing tenderly with the pyogenic membrane, as was formerly done, under the impression that it was a hurtful thing to injure it, we now empty the cavity thoroughly, especially in the case of chronic abscesses, in order to get out all curdy masses of pus which may have gravitated to the bottom of the abscess, and in many cases we scrape out the pyogenic membrane with a sharp spoon. When this is done, opportunity is given for the rapid adhesion of the greater part of the wall of the abscess-cavity.

The abscess is opened with the same precautions as were previously detailed as regards other wounds, the cavity is emptied, contents scraped out in the case of chronic abscesses, and free drainage provided, the points mentioned before being carefully attended to. The same sort of dressing is applied in the same way, with the exception that no protective is required, its use being to promote healing of the incision in the skin. *See* ABSCESS.

So much for wounds made by the surgeon; there remains for consideration the case of wounds produced accidentally. Here the problem is different from, and much more difficult, than the former. In the cases we have as yet been considering, we had merely to keep out septic particles ; in the present instance, these particles have already gained admission, and therefore we have not only to prevent the entrance of more, but also to destroy those already present.

The purification of the wound is effected by washing it out with carbolic lotion, provided the accident happened within twenty-four hours of the case coming under treatment. This must be done very thoroughly. The best way is to use a syringe, with a gum-elastic catheter attached to it. The point of the catheter is introduced into all the recesses of the wound, and the 1–20 lotion is injected through it. Care is taken that the lotion can flow out freely. The skin around must also be thoroughly washed with the same lotion, and all dirt carefully removed. If necessary, the orifice of the wound is enlarged, and in any case free drainage by means of tubes is provided. The drainage and subsequent treatment is the same as in wounds made by the surgeon. If the wound was made twenty-four to forty-eight hours before being seen, a stronger solution is used, viz., the 1–5 spirituous solution. *See* WOUNDS.

W. WATSON CHEYNE.

ANTISEPTICS are substances which are directed against the causes of putrefaction. Now the putrefactive as well as other fermentative processes have been shown to be due to the growth of micro-organisms in the fermenting material. Antiseptics may combat this fermentation in two ways: either they may directly kill the micro-organisms—the cause of the fermentation, or they may by their presence in the fermentable material prevent the growth of these organisms, though they do not interfere with their vitality. In either case the fermentative change does not occur.

The value of antiseptics has been tested in various ways, but the most exact method is that used by Dr. Koch. It is now ascertained that many of these micro-organisms have two stages of existence—an adult form when the organism is rapidly growing, and a resting or spore form which provides for its future existence. It has further been shown that in the adult form these bodies are comparatively easily killed, while in the spore form they are very resisting. In order, then, to test the value of any particular antiseptic as a germicide, it is necessary to determine its relations both to the adult bacteria and to the spores. To do this, threads are impregnated with pure cultivations of these organisms in both conditions, and are rapidly dried. They are then placed in solutions of the antiseptics to be tested, washed in boiled water, and planted in a suitable soil. If they have not been killed they grow; if they do not grow the conclusion is that they have died. In the case of infective organisms the matter can be further tested by inoculating the threads into animals. The spore-bearing organisms generally used are the bacilli of anthrax; the non-spore-bearing ones are micrococcus prodigiosus. To test the value of an antiseptic to prevent the development of micro-organisms, it is mixed in certain proportions with the cultivating materials.

With regard to the antiseptics used in surgery, the following results were obtained in regard to the destruction of spore-bearing organisms.

a. A certain number destroyed the spores of bacillus anthracis within twenty-four hours. These were carbolic acid (5 per cent. in water), chlorine water freshly prepared, bromine water (2 per cent.), iodine water, permanganate of potash (5 per cent. in water), bichloride of mercury ($\frac{1}{20000}$ in water).

b. In the case of some of the solutions the spores had to be immersed for several days before they were destroyed: perchloride of iron (5 per cent. in water) for six days, chloride of lime (5 per cent. in water) for two to five days, quinine (1 per cent. in water), with hydrochloric acid, for ten days.

c. Others, again, had little or no effect on the spores, such as alcohol, glycerine, boracic acid (5 per cent. in water), benzoic acid (saturated watery solution), thymol (5 per cent. in alcohol).

The adult bacteria and non-spore-bearing bacteria are much more easily killed. Thus carbolic acid solution (5 per cent. in water) kills these in less than two minutes; indeed much weaker solutions act very rapidly: sulphurous acid, unless very strong, has little or no effect on spores, but non-spore-bearing bacteria, if moist, are killed in one to two minutes by a vapour containing ·986 volume per cent. of sulphurous acid; solutions of bichloride of mercury in water of 1 to 5,000, or stronger, probably kill instantly.

For surgical purposes it is also of great importance to know what amount of the disinfectant must be present in any given material to prevent the development of the organisms. Here, also, the bichloride of mercury is by far the most potent, for added to a gelatinised infusion of meat in the proportion of 1 to 3,000,000 no development occurred. Allyl alcohol is also very potent, a very small trace being sufficient to hinder development. Carbolic acid, boracic acid, salicylic acid, benzoic acid, and eucalyptol, prevent development in proportions varying from 1 to 700 to 1 to 1,500; quinine 1 to 625; chloral under 1 to 400; alcohol 1 to 12½; iodine, chlorine, and bromine, 1 to 1,000 to 1 to 5,000.

In selecting these substances for the treatment of wounds, there are several points to be borne in mind, of which the following two are perhaps the most important. In the first place several of the materials mentioned before combine with albumen, and the resulting mixture or compound is generally less powerfully antiseptic than the original substance. Thus, if carbolic acid is added to such a material as Pasteur's fluid (a solution of various salts), a proportion of 1 to 600, or less, is sufficient to prevent development, while in the case of milk the writer has found that the amount of carbolic acid requires to be increased to about 1 to 50 before complete arrest of development occurs. And thus in the case of the discharge from wounds, an antiseptic, which by the above method of investigation is found not to be very powerful, may in reality answer the purpose better than one which is stronger. A striking example of this is shown in recent experiments of Schill and Fischer on the disinfection of phthisical sputum. For it was found that bichloride of mercury, which in reality is the most powerful of antiseptics when added to phthisical sputum even in strong solution, did not destroy the tubercle bacilli so rapidly as carbolic acid.

Another point to be noted is that some of these antiseptics are objectionable on account of their poisonous and irritating properties. Thus one of the chief objections to corrosive sublimate is the fact that when used sufficiently strong to be really effectual, it causes inflammation of the skin. Of course this objection may in some instances be overcome, and in fact, with regard to corrosive sublimate, Sir J. Lister finds that, when mixed with serum, it loses to a great extent its irritating properties, while it still retains a sufficient amount of antiseptic power.

The manner of using these various antiseptics in the treatment of wounds will be found under ANTISEPTIC SURGERY.

W. WATSON CHEYNE.

ANTRUM, Diseases of the. — *Suppuration or Empyema of the Antrum* is a form of chronic abscess, but with the peculiarity that the pus is seldom completely shut in, so as to produce distension.

In the great majority of cases, the matter constantly escapes by the anterior or posterior nares, and it is this discharge which first attracts the patient's attention.

When escaping from the anterior nares upon the handkerchief, the discharge is apt to be attributed erroneously to ozæna, but the absence of the characteristic crusts and fœtor sufficiently mark the distinction. In ozæna, the patient as a rule has lost the sense of smell, and is unconscious of his offensiveness, whereas in cases of pus in the antrum the patient is conscious of an occasional unpleasant odour, but is not disagreeable to his neighbours, though the discharge when blown on to the handkerchief may be offensive.

Often a patient suffering from pus in the antrum, complains only of a disagreeable taste in the throat and mouth on waking in the morning, particularly if he sleeps habitually on the side opposite to that of the affected antrum, the purulent fluid then slowly flowing backwards into the pharynx, and being partially swallowed, with great detriment to the digestion.

In the exceptional cases where the opening into the nose is closed, the pus tends to accumulate, and produce distension of the antrum, with absorption of the bony walls, by which the characteristic crackling is produced. It may be doubted, however, whether some at least of these cases are not instances of cyst of the wall of the antrum, the contents of which have become purulent.

In cases of distension the pain is severe, and of a neuralgic and intermittent character, but in the ordinary form there is little more than an occasional sense of uneasiness and weight about the jaws, so indistinct as often to be no guide to the side on which the mischief exists. In the great majority of cases empyema of the antrum depends upon inflammation of the lining membrane of the cavity, caused by the fangs of decayed teeth, which, if not actually perforating the membrane, are in close proximity to it, either from unusual depth of the sockets, or from absorption of the intervening thin portion of bone. It is possible, however, that the mischief may be set up by extension of catarrhal inflammation from the nose, by blows on the face, or even by the pressure of parturition in the case of an infant.

A careful examination of the teeth will, in most cases, show which of them is in fault, and though the first and second molars are those of which the fangs most frequently cause mischief in the antrum, it must be remembered that the canine frequently, and the incisors more rarely, are connected with an unusually extensive antrum.

The extraction of a decayed tooth or fang may be followed by an immediate discharge of pus, in which case an enlargement of the opening will probably be required, but frequently the tooth which set up the mischief has been long extracted, and it then becomes necessary to perforate above the alveolus. For this purpose a perforator, a gimlet, or an ordinary trochar of medium size may be employed. If the bone happens to be thin any instrument passes through readily, and the operator is aware that he has entered a cavity, and may, if he does not hold the perforator judiciously short, transfix it, and come in contact with orbital plate. But in many cases the bone is extremely dense, and the instrument is gripped so tightly that it is impossible, until it is withdrawn, to be sure that the cavity of the antrum has been reached.

Whether the perforation be made through or above the alveolus, an ordinary Eustachian catheter of silver or vulcanite will be found very convenient for washing out the antrum, and a simple india-rubber ear-syringe with a bullet-joint will be sufficiently powerful for the purpose. Ordinarily, fluid injected through the perforation flows readily from the nose, bringing away a quantity of more or less inspissated pus of an offensive character; but occasionally the cavity of the abscess does not communicate with the nose, and the fluid must then be allowed to flow back by the perforation.

The after-treatment of these cases consists in maintaining the aperture, which is often difficult, until all purulent secretion has ceased, in washing out the cavity at least twice daily with warm Condy's fluid and water, and in throwing in a small quantity of stimulating lotion such as

Zinci sulphatis, gr. ij. ad v.; Aquæ rosæ, f℥j.

When the opening is above the alveolus, there is little danger of particles of food entering the cavity; but when the perforation is through the alveolus, food will readily penetrate, unless an artificial denture be applied so as to cover the opening during mastication. If this is employed, a tube should be fitted to the perforation so as to maintain its calibre, and thus the occasional introduction of a trochar may be dispensed with. Still, it must be allowed that the cure of empyema of the antrum is often very tedious, and that many months may elapse before a patient can dispense with daily washing out of the cavity.

Since, as has been already said, distension of the antrum with facial deformity occurs only in cases in which the matter does not discharge into the nostril, it is easy to mistake an instance of the kind for a solid tumour of the upper jaw, should the amount of distension not be sufficient to produce much thinning and crackling of the bone. Again, it appears possible that the fluid portion of the matter contained in the antrum may drain away, leaving behind it a solid mass of inspissated pus and cholesterine, which, as in a case of the writer's, may by its presence induce partial absorption of the floor of the antrum with a protrusion of the palate, and all the symptoms of maxillary tumour. In order, then, to avoid an error which has overtaken very excellent surgeons, it is advisable in all cases of tumour of the upper jaw in which the nature of the swelling is not obvious, to perforate the antrum beneath the cheek, before incising the skin of the face and taking the necessary steps for removal of the jaw.

The secondary effects produced by distension of the antrum are sometimes serious. Thus protrusion of the eyeball from elevation of the floor of the orbit is not infrequent, and cases of permanent amaurosis have been recorded by Salter and Gaine, while occasionally death has been known to follow suppuration within the antrum.

Cysts of the upper jaw are by no means uncommon in which no connection with the teeth can be made out, but which certainly do not fill or in any way occupy the antrum. In fact it may be doubted whether the old term 'hydrops antri' is not altogether a misnomer, the cases which have hitherto been grouped together under that name, being either cysts of the wall of the antrum, or cysts altogether outside the antrum, pushing in its wall as they develop. The history of these cases is one of gradual, painless enlargement of some part of the upper jaw, usually close above the alveolus, the bony wall becoming so thin as to crackle like parchment, or eventually being simply membranous, in which case a characteristic bluish appearance is seen on lifting the lip, and fluctuation can be readily perceived.

In the earlier stage of the complaint, when the jaw is distended and absorption is not so far advanced as to make the nature of the case clear, a puncture with a trochar will probably evacuate cystic fluid, often containing cholesterine, and differing entirely from the mucous secretion of the lining membrane of the antrum. On incising a cyst a quantity of dark-coloured fluid of varying consistency escapes, and the finger passes into a smooth cavity not perforated by the fangs of teeth, and quite outside the antrum. By cutting away a portion of the cyst-wall so as to insure a free drainage, the cure of the cyst is gradually brought about, but very slowly. The same form of cyst is found, but less frequently, in the lower jaw.

Adams, Giraldés, and Luschka have shown that both single and multiple cysts develop occasionally from the wall of the antrum, and project into the cavity, and that polypoid growths form in the same situation. A case recently recorded by Sir James Paget supplies a symptom of such polypoid growths hitherto unnoticed, viz., the constant flow from the nostril of the affected side of clear watery fluid in considerable quantity. The patient, a lady aged 49, suffered for nearly two years from this inconvenience, and was then relieved, and ultimately cured, by the use of sulphate of zinc, locally and internally, as recommended by Brodie in a similar case. The patient dying from causes unconnected with the antrum, its 'floor was found to be covered with two broad-band convex polypoid growths, deep clear yellow with the fluid infiltrated in their tissue. They looked like very thin walled cysts, but were formed of very fine membranous or filamentous tissue infiltrated with serum.'

Epithelioma.—The tubular form of epithelioma may originate in the antrum, or, commencing in the nose, may secondarily invade the antrum. The growth is characterised by great rapidity of development and softness, and the surrounding structures are apt to be rapidly involved. Hence tumours of this class were formerly considered as examples of soft cancer. When beginning on the nasal mucous membrane, the stoppage of the nostril is generally the first symptom noticed, and possibly temporary relief may be obtained by the removal of so-called polypi. When the disease begins in the antrum it leads to a rapid expansion of the cheek, with stretching and thinning of the skin, which eventually becomes involved and ulcerates, giving exit to a fœtid watery discharge and the protrusion of a yellow fungous growth. The nose and the orbit become secondarily involved, and the growth is apt to find its way into the several fossæ of the outside of the skull.

In the treatment of this form of disease early and free removal of the upper jaw offers the only chance of permanent cure.

CHRISTOPHER HEATH.

ANUS. *See* ATRESIA ANI; FISSURE OF THE ANUS: PRURITUS ANI.

AORTA, Abdominal. *See* ABDOMINAL ANEURISM.

AORTIC ANEURISM has of late years been submitted to surgical treatment with an encouraging amount of success. As regards the pathology, diagnosis, and general treatment of aneurism of the arch of the aorta reference must be made to medical treatises, and the writer will confine himself to the indications for surgical interference of various kinds.

A sacculated aneurism of the arch of the aorta is to be diagnosed in the early stages by its pressure effects, viz., pain, venous congestion and dyspnœa. The position of the sac will materially influence each of these; thus a sac pressing against the sternum is more painful than one pressing back against the trachea, whilst the latter will give rise to urgent dyspnœa in a very early stage. Increased dulness on percussion is a very important sign, and when this is combined with a strong impulse synchronous with the impulse of the heart, but not necessarily accompanied by a *bruit*, the diagnosis of aortic aneurism is confirmed.

The tendency of an aortic aneurism to appear externally is regulated very much by the site of the sac. If on the ascending portion of the arch, the sac presses against the sternum, producing gradual absorption of the front wall of the chest, and communicating a marked impulse to the right side of the sternum as high as the sterno-clavicular joint, which may be invaded by the tumour in the later stages. If on the transverse portion of the arch the sac encounters but little resistance in an upward direction, and hence is apt to invade the interclavicular notch, to compress the trachea and occasionally the œsophagus, and to produce marked spasm of the larynx by interference with the left recurrent laryngeal nerve. When a sac of this kind rises into the neck it is a matter of uncertainty to which side it should be allotted, since a tumour projecting most to the right by no means necessarily *originates* on the right side, and *vice versâ*. Some assistance in diagnosing this point may be derived from the radial pulses, which should be carefully examined both with the finger and sphygmograph. A diminution of the right radial pulse would generally indicate an aneurism of the root of the innominate; but the fact must be borne in mind that occasionally the right subclavian comes off from the lower part of the arch and may be compressed by an aneurism of the arch or by some other tumour. It becomes necessary, therefore, to compare the two carotids and to investigate the blood-supply of both sides of the head. The condition of the pupil on the affected side should also be noted, since it is not infrequently contracted from interference with the sympathetic trunk, though in certain other cases dilatation has been noted.

Given a case of aneurism of the arch of the aorta, in which the symptoms are steadily increasing in severity, notwithstanding the employment of rest, regulated diet, and various drugs, the question of surgical interference may be fairly entertained under the heads of *a*, distal ligature; *b*, galvano-puncture; *c*, introduction of certain foreign substances:—

a. The distal ligature may be applied to either carotid and either subclavian; or to the two vessels of the right side, either simultaneously or consecutively. Dr. Cockle was the first to direct attention to the remarkable curative effects produced (under a mistaken diagnosis) upon aneurisms of the arch, by ligature of the left carotid in the hands of Rigen and Tillanus, and at his suggestion the writer tied the left carotid in a case of unquestioned aortic aneurism in 1872. The patient, a farm-labourer of forty-eight, had well-marked symptoms of aortic aneurism, which was thought to involve the transverse portion of the arch.

The relief afforded by the ligature of the left carotid was marked. Within forty-eight hours the patient was able to lie on his right side, which he had previously been unable to do. The prominence of the right side of the sternum and right sterno-clavicular articulation gradually subsided, and the pulsation in the episternal notch disappeared. A year after the operation the patient was well and quite comfortable, and a few months later resumed his laborious occupation, with the result that the aneurism began again to increase and eventually burst in the middle line externally, four and a half years after the operation. The aneurism proved to be one of the ascending portion of the arch. The operation has been repeated by Holmes, Barwell, Pirogoff, Küster, and the writer, whose second case proved rapidly fatal from cerebral anæmia, the right carotid proving to have been previously occluded. Still the relief given in at least seven cases is very encouraging, and since, with improved methods of tying large vessels (*see* LIGATURES), the risk of tying the common carotid is considerably reduced, it may be hoped that the operation will be more extensively employed than heretofore.

The double distal ligature has been frequently applied on the right side, and once at least (Barwell) on the left side. In the majority of instances the double ligature has been performed for supposed innominate aneurism more or less involving the aorta, but in several examples the disease has proved to be purely aortic, as in the writer's case which occurred in 1865, the patient surviving four and a half years. Mr. Barwell, in 1879, first applied the double distal ligature on the right side for aneurism diagnosed as aortic, the patient living fifteen months in fair health and comfort, and he was followed by Dr. Lediard, whose patient lived ten months, and by Dr. Wyeth, whose patient lived one year.

Mr. Barwell (*International Encyclopædia of Surgery*) has endeavoured to distinguish the two classes of cases suitable for the distal ligature as follows :—

'*For Deligation of Left Carotid.*—Tumour symptoms upon and somewhat, but not far, to the left of middle line, and rising into episternal notch, or beneath left sternomastoid. Left venous congestion, alteration of left carotid, and to a much less degree, of left radial pulse. Paralysis of left vocal cord; obstruction to entrance of air, equal on both sides of chest; sometimes alteration of left pupil.

'*For Deligation of Right Carotid and Subclavian.*—Tumour symptoms on right of median line; marked changes in right radial and carotid pulses; venous congestion on right side, affecting first and chiefly head and neck. Afterwards, with increase of tumour, right arm and chest and right vocal cord may be paralysed; or, tumour symptoms on right of and upon mesial line, running up to sterno-clavicular joint and episternal notch; venous congestion on left side; alteration of right pulse, tracheal dyspnœa.'

It appears to the writer, however, impossible to lay down any hard-and-fast diagnostic lines, since each case must be taken on its merits; but he would remark that in both his cases of distal ligature which survived the operations over four years and a half each, the aneurism was on the ascending portion of the arch, and that both patients were equally benefited, the one by the double ligature on the right side, the other by a single ligature on the left. The balance of safety lies therefore clearly, *cæteris paribus*, in favour of a single ligature on the *left* side.

b. The production of clot within an aortic aneurism by the employment of electrolysis will be discussed under that heading.

c. The introduction of foreign bodies into an aneurismal sac, with the view of entangling fibrine and thus bringing about a cure, is a very desperate remedy. The first case in which the late Mr. C. Moore introduced many yards of fine iron wire, died of acute pericarditis and general inflammatory symptoms due to the foreign body. No better results have followed the substitution of horsehair. Probably the safest foreign body will be found in fine darning-needles introduced in pairs and crossing one another within the sac, so as to entangle the blood and lead to coagulation. The small experience of Mr. Marshall and the writer has been favourable as regards the innocuousness of the method, but not as respects the permanent effects of the treatment. Further experience is wanted as to the time during which the needles may be safely retained—probably at least forty-eight hours. Mr. Puzey's very interesting case will be found in the article ACUPUNCTURE.

CHRISTOPHER HEATH.

AORTIC TOURNIQUET.—A large horse-shoe tourniquet contrived by Lister for compressing the abdominal aorta immediately to the left of the umbilicus in amputating at the hip-joint. *See* DAVY'S LEVER.

APHONIA, i.e. loss of voice—hoarseness or dysphonia, if the voice is only impaired—is caused by conditions in which (*a*) the expiratory current of air is too weak to throw the approximated and tense vocal cords into vibration; (*b*) the approximation of the vocal cords is impeded; (*c*) their tension is either rendered impossible or is excessive; (*d*) the cords themselves are pathologically changed; (*e*) their vibration is rendered impossible.

Such conditions are met with—

(*a*) 1. In cases of emphysema and of extreme general weakness. 2. In cases of complete, or nearly complete, obstruction of the lower air-passages by internal tumours, foreign bodies, sub-glottic webs, external compression. 3. After tracheotomy or wounds of the trachea.

(*b*) 1. In cases of nervous paralysis, as (*α*) in bilateral or unilateral paralysis of the recurrent laryngeal nerves; (*β*) in functional paralysis of the adductors of the vocal cords; (*γ*) in paralysis of the inter-arytænoid muscle; (*δ*) in paralysis of individual adductor muscles in consequence of local disease. 2. In cases of serous infiltration of the phonatory laryngeal muscles arising in catarrhal and inflammatory affections of the larynx. 3. In cases of mechanical fixation of one or both vocal cords in positions other than that of phonation. This may be due (*α*) to cicatrices binding the cord, or cords, to the sides of the larynx; (*β*) to disease of the crico-arytænoid joints, followed by ankylosis; (*γ*) in cases in which anything intervenes between the cords, when they attempt to join. This may happen (*α*) in cases of swelling of the interarytænoid fold; (*β*) in cases of foreign bodies in the larynx; (*γ*) in cases of benign or malignant neoplasms situated within the glottis.

(*c*) 1. In cases of paralysis of (*α*) the crico-thyroid muscles; (*β*) the interior thyro-arytænoid muscles. 2. In cases of ankylosis of both crico-arytænoid joints, in which, though they are fixed in the position of phonation, they are simultaneously bound internally and forwards, so that the cords, though approximated, remain quite lax. 3. On the other hand, a peculiar form of aphonia is produced in spasm of the tensors and adductors (speaker's cramp, aphonia spastica).

(*d*) In many cases of inflammatory or ulcerative disease of the larynx, as in: (*α*) acute laryngitis, (*β*) chronic laryngitis, (*γ*) œdema of the larynx, (*δ*) benign neoplasms, (*ϵ*) carcinoma and sarcoma, (*ζ*) syphilis, (*η*) tuberculosis, (*θ*) perichondritis, (*ι*) lupus, (*κ*) lepra of the larynx, (*λ*) direct injury of the vocal cords.

(*e*) 1. In cases of swelling of the ventricular bands and chronic laryngitis, the swollen parts resting on, and preventing the vibrations of, the vocal cords. 2. In cases of benign neoplasms resting on the vocal cords, and acting similarly.

It is obvious that in many cases there will be a coexistence of several of the conditions just enumerated.

If the class of cases mentioned in (*a*), in which the cause of the aphonia or dysphonia will either be obvious, or become patent from physical examination of the chest, be excluded from consideration, varied, and pathologically different, laryngeal conditions remain, in which this symptom is present. It is true, that in some of these conditions, as in bilateral paralysis of the recurrent laryngeal nerves (see *Paralysis* and *Spasm* under LARYNX, Neuroses of the), hysterical aphonia, and in spastic aphonia, the vocal disorder manifests itself in a very characteristic form, but even in these cases errors are not excluded, if one trusts only to the patient's history, and to the recollection of apparently similar cases. Thus the writer has known enormous laryngeal papillomata to have been mistaken for hysterical aphonia, speaker's cramp for pharyngitis, &c. In all other cases of aphonia or hoarseness, the diagnosis of the nature, and, still more, of the special form and the extent of the morbid influence, without the aid of the laryngoscope, is purely guesswork; and the most experienced observer will occasionally be liable to serious mistakes, if he trusts to the history of the case, to the general symptoms, and to his auditory faculties alone.

A certain diagnosis of the nature, form, and extent of the cause of aphonia can only be arrived at by combining laryngoscopic examination with the methods just mentioned. In this manner, and on reference to the above list of conditions giving rise to aphonia or dysphonia, the special cause of aphonia in a given case will be elucidated. The peculiarities of all these conditions are fully discussed under LARYNGITIS; LARYNX, Neuroses of the, and Growths in the.

FELIX SEMON.

APHTHÆ. *See* TONGUE, Diseases of the.

AREOLA. *See* NIPPLE AND AREOLA, Diseases of the.

ARM, Amputation of the.—The conditions which, as a rule, necessitate amputation of the arm are compound and extensively comminuted fractures, such as are produced by gunshot injuries, gangrene, strumous disease of the elbow-joint of an extent to contra-indicate resection, necrosis, burns of exceptional severity, contused and lacerated wounds, malignant tumours of the hand or forearm, &c.

The following are the methods practised for this operation, which may be performed at any point below the attachments of the axillary muscles:—

1. The circular method.
2. Syme's modification of the circular.
3. Alanson's method.
4. Oval method (Guthrie).
5. Square-shaped flap method (Sabatier).
6. Antero-posterior flap method (Vermale).
7. Lateral flap method (Velpeau).
8. Musculo-cutaneous flap method (Langenbeck).
9. Long anterior oval flap.
10. Rectangular flap method (Teale).

Of these methods the circular is, in the majority of cases, to be preferred; but the surgeon must use his own discretion in the choice, his selection being guided by a careful consideration of the particular circumstances attending each case.

Speaking generally, he must, in cases especially of serious traumatism requiring amputation, utilise for flaps the integumentary and muscular tissues that are least involved in the injury. For such cases, therefore, no definite rules as regards length, breadth, or shape of the flaps, can be stated. In cases of disease, however, it is different. Here the structures, where the operation is performed, being healthy, the surgeon can select the procedure which, in his opinion, is attended with least risk, and is best adapted for an artificial arm, or other mechanical appliance.

In performing the foregoing amputations, provision must be made to prevent hæmorrhage by one of the following methods:—(1) Esmarch's bandage; (2) Petit's tourniquet on upper part of the arm; (3) Signoroni's tourniquet; (4) digital pressure on brachial artery; (5) digital pressure on axillary artery; (6) pressure on subclavian against first rib.

In the circular amputation, supposing the right arm is the one to be operated on, the surgeon grasps with his left hand and retracts the soft tissues, and with a straight, or somewhat curved, blunt-pointed amputation knife, divides the integument and superficial structures, with a single circular sweep round the limb, severing all the tissues down to the muscles. A flap, consisting mainly of integument and fat, should be dissected back with a full-sized scalpel for a distance of at least an inch and a half, care being taken to include all the subcutaneous tissues with the view of preserving the vitality of the flap. Having dissected and retracted this flap, the amputation knife is then applied to the muscles, and all of them divided at once down to the bone; or the superficial ones may only, in the first instance, be divided, and subsequently the deeper ones, with the vessels and nerves. Owing to the non-attachment of the biceps to the humerus, and the greater tendency it has in consequence to retract, it has been recommended to divide it at a somewhat lower point than the other muscles. The plan of dividing the superficial muscles, and subsequently the deeper ones, is, in the writer's opinion, to be preferred. The muscles having been divided, and the periosteum reached, it should be carefully incised at the point where the saw is to be applied, and the bone then sawn steadily and slowly across. Should the edges of it be sharp, they should be rounded off, either with the saw or bone-forceps, any spicula of bone being removed. The brachial, the superior and inferior profunda arteries, together with muscular branches, will probably require ligature, and should be seized with an artery forceps or tenaculum, and secured with strong carbolised catgut suture, and both ends cut short. If the plan of inserting deep, as well as superficial, sutures, as recommended by Esmarch, be not adopted, provision should be made for efficient drainage, and the edges of the flaps brought together with numerous points of carbolised or chromicised catgut sutures of medium thickness, antiseptic dressings being then applied.

As regards the other methods of amputation, the writer is of opinion that the merits of Syme's modified circular method are not so apparent in amputations of the arm as in those of the leg, thigh, and forearm. The circular operation just described, in which the muscles are divided in layers, includes the advantages claimed for Alanson's operation, in which the muscles are divided obliquely, in both instances the wound being more or less cone-shaped. In the 'oval' method, the writer fails to see any special merit, and none whatever in the 'square flap' method of Sabatier. The antero-posterior and lateral flap operations, and the musculo-cutaneous flap amputation (Langenbeck), possess advantages which, in the opinion of many surgeons, make their adoption desirable, from the rapidity with which they can be done, and the shapely stumps that result. The rectangular method of Teale, applied to the arm, has many advocates; but, in the writer's opinion, its merits—and they are many—are more apparent in amputations of the thigh than in any others; and in connection with that group of operations, therefore, the method will be more fitly discussed.

In performing the antero-posterior flap method, made by transfixion, care should be taken in making the anterior flap to get the knife in front of the brachial vessels, which can best be done by lifting the anterior muscles well up before transfixing them. The posterior flap should be made somewhat longer than the anterior, which latter should be from two to three inches in length. The flaps then being retracted, any muscular fibres attached to the bone should, with the periosteum, be divided carefully, and the bone then sawn across. The remaining steps of the operation are similar to what has already been described in connection with the 'circular' amputation.

These methods will probably meet the requirements of the surgeon in the majority of cases. William Stokes.

ARM and FOREARM, Diagnosis of Injuries and Diseases of the.—Loss of power, pain, swelling, probably distortion, mobility in the continuity of one of the bones, with crepitus on manipulation, following immediately upon injury, are the signs of *fracture.* The humerus is occasionally the seat of *spontaneous fracture,* which in old subjects may be the result of malignant disease of the bone.

Loss of extension power following a fall on the elbow or other direct injury, with pain and swelling behind the joint, where a hard movable mass can be felt, indicates *fracture of the olecranon* with separation; if the fibrous structures around the bone are not torn across, no separation occurs, and the power of extension is not lost. *A movable bony mass* at the inner side of the elbow, after a direct blow on the part, is probably the internal condyle, which has been chipped off; a similar movable mass in other situations may be the result of a fractured exostosis.

Bony distortion about the elbow immediately consequent on injury must be due to *fracture* or *dislocation,* perhaps both. Deformity with crepitus means fracture—possibly dislocation also; without crepitus it means almost certainly dislocation—very rarely *impacted fracture.* The two conditions which may resemble dislocation are, transverse fracture just above the condyles and, in young subjects only, *separation of the epiphysis* at the lower end of the humerus. In the normal state the tip of the olecranon in extension is exactly on the level of the line of the condyles—never above it; in semiflexion it lies vertically below that line—never in front or behind. In fracture or separation of the epiphysis the whole elbow-joint may be displaced, but the relation of the olecranon to both the condyles remains unaltered; any change, therefore, in these relations indicates *dislocation of the ulna* from the humerus. Displacement due to fracture is reproduced immediately after reduction by muscular action; a dislocation, on the other hand, has not this tendency to recur. In *dislocation of the radius* only the relation of the olecranon to the condyles is unchanged, and the absence of the radial head from its usual situation below the external condyle is easily detected.

An abrupt angular bend is often found in young children, at about the middle of one of the bones, and may arise from rickety deformity, greenstick fracture, or, very rarely, intra-uterine fracture. In adults permanent angular deformity is usually due to vicious union after fracture.

Permanent *shortening of the limb,* independent of loss of bony tissue from compound fracture or operation, may be the result of congenital defect, arrest of growth after fracture in infancy, injury or disease of one of the epiphyses of a growing bone, or infantile paralysis. *Lengthening* occurs very rarely in chronic ostitis and in certain cases of osteitis deformans.

Wasting of one or more of the muscles may be due to:—(1) prolonged disuse; (2) injury to the nerves; (3) inflammation in or around a muscle; (4) acute or subacute joint-disease; atrophy of the muscles about the elbow should therefore induce careful investigation of the articulation. In children infantile paralysis is a common cause of wasting of muscles, especially the deltoid. *Hypertrophy* of some of the muscles may be the result of excessive use, and is also present in rare cases of pseudo-hypertrophic paralysis.

Rigidity of the biceps, causing 'bent elbow,' may be produced by:—(1) old inflammation about the muscle; (2) passive contraction from long use of a sling; (3) reflex contraction from disease of the elbow, or from a wound of a cutaneous branch of the musculo-cutaneous nerve.

Stiff elbow may arise from:—(1) prolonged disuse; (2) adhesions in or around the joint from old disease; (3) bony ankylosis after disease, fracture, or excision; (4) contraction of scars, probably of burns; (5) reflex rigidity of muscles; (6) deformity from fracture; (7) unreduced dislocation; (8) deformity in osteo-arthritis; (9) bony thickening after periostitis.

Loss of power of rotation in the forearm, either by voluntary or passive movement, which is persistent and complete, is found in complete ankylosis of the elbow, in vicious union after fracture of the radius and ulna, and in obliteration of the interosseous space by callus or periosteal bone.

The distressing pain and weakness known as '*tennis-elbow*,' often seen about the upper part of the forearm and elbow in players of lawn-tennis, particularly during the action of pronation, is the result of sprain of the pronator radii teres and internal inter-muscular septum. Similar symptoms, '*sculler's sprain*,' are sometimes met with amongst boating men who 'feather' their oars. An elongated tense swelling over the course of any of the tendons above the wrist, which when moved produce a peculiar creaking in the tumour, coming on, as a rule, after a sprain, or violent twisting movements, indicates *teno-synovitis.*

Sudden loss of power and sensation from interruption of nerve-supply may be caused by:—(1) injury to a nerve by direct wound; (2) complete or incomplete division of a nerve, probably the musculo-spiral, by the fragments of a fractured bone; (3) a violent blow on a nerve as it lies close upon one of the bones. In children, especially about the time of 'teething,' sudden loss of power without loss of sensation is due to infantile paralysis. *Gradual paralysis* following upon fracture is probably caused by implication of the nerve in callus; independently of fracture, it is usually crutch-paralysis or lead palsy.

Sudden, acute pain in the arm during violent attempts at flexion, immediate loss of power, swelling, and extravasation, with a rounded tumour in the mid-bicipital region and a depression above the elbow instead of the normal fulness, indicate *rupture of the biceps.* Rapid *subcutaneous extravasation* and discoloration, ensuing directly upon a strain or blow, point to a ruptured vein.

A pulsating swelling appearing rapidly or slowly after a similar injury means *rupture of an artery*, probably the brachial, and the formation of a traumatic aneurism. A pulsating tumour does not always follow rupture of the artery, in which case the history of the injury and the absence of the pulse below the rupture will point to the diagnosis. Punctured wounds over either of the large vessels may involve the artery, and should be carefully watched, as an immediate *traumatic* or *consecutive aneurism* may result.

A rounded, well-defined tumour in the course of either of the large arteries, pulsating in all directions, is probably an *aneurism*; a distinct blowing or rasping bruit is heard on auscultation, the pulse in the artery below is diminished; pressure on the vessel above arrests the pulsation in the tumour and causes a decrease in its bulk. A pulsating, rapidly-growing mass, possibly of large size, involving one of the bones, probably the humerus, with a soft purring bruit and no alteration in the pulse below, points to *osteoid cancer.*

Fulness and tortuosity of the veins over the bend of the elbow, with pulsation and a soft bruit, are the symptoms of *aneurismal varix*: if, in addition, a distinct pulsating tumour exist, the case is one of *varicose aneurism.*

Stiffness, pain, and tenderness about the elbow, with gradual distension of the synovial membrane, which bulges on each side of the olecranon without obscuring the bony points, are the symptoms of *synovitis*, which may be traumatic, rheumatic, gonorrhœal, or syphilitic. Immediate distension of the joint after injury is caused by effusion of blood. In children, synovitis is usually the effect of injury or 'struma,' or both; if the swelling slowly becomes uniform over the whole elbow, the bony eminences being obscured, *pulpy or 'fungous' disease* of the joint has set in.

The sudden appearance of fluid in the elbow-joint, in patients affected with open sores or suppurating cavities, points to *secondary pyæmic abscess.* Chronic effusion into the elbow-joint, with rough creaking and, in the later stage, bony crepitus and deformity, without very acute pain, as a rule is common in patients past middle age, as the result of chronic *osteo-arthritis.* A similar but quite painless condition, *Charcot's disease*, is found sometimes in those affected with locomotor ataxy. *Bony crepitus* in the elbow may be the consequence of fracture, acute or chronic disorganisation, osteo-arthritis, or Charcot's disease.

Vivid streaks running up the limb, with stiffness, swelling, and tenderness of the lymphatic glands in the axilla or above the elbow, indicate *lymphangitis*. Bright redness, rather diffused excepting at its upper limit, disappearing momentarily on pressure, with a tendency to spread in all directions, slight œdema and stabbing pain, are the signs of *erysipelas*. In young subjects, especially anæmic girls, about the time of puberty, bright red, raised, and circumscribed patches, which appear rapidly and subside in a few days, leaving marks like a fading bruise, are typical of *erythema nodosum*.

General chronic *œdema of the limb* may exist as a sequel to erysipelas or cellulitis, may be caused by obstruction of the venous circulation from thrombosis, or pressure on the veins by tumours or enlarged glands, and may arise from constriction high up accidentally, or in cases of neuro-mimesis and malingering.

Intense pain, tenderness and swelling over either of the bones, without redness in the earlier stages, occurring after exposure or slight injury in young subjects, are almost certain evidence of *acute periostitis*. Dull aching pain, increased at night with some thickening, often ill-defined, and tenderness about one of the bones, occurring most frequently in adults, points to *chronic periostitis*, or *ostitis*. A well-marked circumscribed swelling on the bone, with symptoms of chronic or subacute periostitis, is a *node*, which in adults is, as a rule, syphilitic, in children strumous. A painful, tender swelling around the line of one of the epiphyses, usually that at the lower end of the humerus, not involving the neighbouring joint, excepting in neglected cases, occurring in children who are the subjects of congenital syphilis, is not infrequently seen as a consequence of *syphilitic epiphysitis*, and must be carefully distinguished from pulpy disease of the joint.

An oval, fluctuating swelling, not as a rule painful or tender, over the olecranon, is the result of chronic effusion into the olecranon bursa, '*miner's elbow*,' and is prone to become acutely inflamed after slight injury. A rounded, fluctuating swelling over the lower end of the bicipital groove, slightly movable and not very tender, should lead to a careful examination of the shoulder-joint, as such a tumour is sometimes formed by *synovial extension* in chronic or subacute disease of that articulation. *See* Shoulder.

A rather hard, fairly-defined mass, situated in the substance of one of the muscles, usually the triceps, often of considerable size, remaining for a long period without change, is probably a *gumma*. Ragged sores, with bases of slough resembling wash-leather, the result of broken-down gummata, are common about the region of the internal condyle of the humerus.

Any rapidly-increasing growth, hard or soft, painless or painful, covered with large veins, which involves all the structures around, infiltrating the skin so that it becomes adherent, is due to *malignant disease*.

A hard, fixed, circumscribed, slowly-growing tumour, springing from either of the bones near one of its extremities, causing little inconvenience excepting that produced by its weight and size, is probably an *enchondroma*. A mass of bony hardness, usually pedunculated, and not very large, springing from either of the bones, absolutely fixed, neither tender nor painful, unless a nerve or muscle is stretched over it, and growing extremely slowly or not at all, is nearly certain to be an *exostosis*. Bony tumours not being exostoses are due to the existence of (1) a supra-condyloid process; (2) ossified nodes; (3) ossified callus about an old fracture. *See* Hand, Surgery of the.

William H. Bennett.

ARNOLD'S LEG-SPLINT consists of a piece of tinned sheet-iron, bent slightly opposite the knee, and turned up at right angles at the lower end, to form a footpiece. The splint should be broader than the leg, so that the latter is not compressed too much by the side splints, which are straight pieces of wood reaching from just above the knee to the footpiece. A strap and buckle should be attached to the lower end of each, by means of which they may be fastened together round the footpiece. The splint is slung to a wooden cradle by straps fixed to two pairs of cross-bars, one just below the knee, and the other just above the ankle.

Bilton Pollard.

ARTERIES, Diseases of.—The diseases of the arterial system may be arranged in the following order:—I. Inflammation and ulceration. II. Degeneration. (*a*) fatty, (*b*) calcareous, (*c*) amyloid. III. Atrophy. IV. Hypertrophy. V. Nervo-muscular disturbance—Raynaud's disease. VI. Embolism. VII. Thrombosis. VIII. Tumours.

I. Arteritis.—Inflamed arteries vary greatly in appearance, the diversity depending on essential or accidental circumstances. Thus the process may be acute or chronic; it may affect by preference larger or smaller vessels, and incidentally one or other of their coats; whilst it may constitute the sole morbid change, or be associated with retrograde metamorphosis, coincidental or consecutive. Hence it is customary to enumerate several kinds of arteritis. At the same time it should be borne in mind that apparently distinct pathological lesions may in reality be only successive stages of a protracted disorder of nutrition.

(A) *Acute Arteritis.*—It is now generally conceded that there is no such disease as *acute general arteritis.* The description formerly given of this supposed erysipelatous condition was founded on error; the staining of the intima with hæmoglobin discharged from the corpuscles being mistaken for inflammatory redness, and decolorised disintegrated blood-clot for purulent effusion. Moreover, at that period arteritis was believed to be a necessary antecedent to thrombosis, and primary diffuse arterial thrombosis, though rare, is known to occur, e.g. in the course of malignant blood-poisoning.

Acute local arteritis is a necessary consequence of severe injury to a vessel; thus it follows partial rupture from accident, and is the means by which an artery is permanently occluded after the application of a ligature. In these instances it is clearly conservative. Acute destructive local arteritis arises by extension of unhealthy inflammation from surrounding tissues. It is most common where the products of exudation are pent up under high pressure, or are allowed to decompose in an open wound. The end of an artery in an amputation stump may be attacked, and then the danger of secondary hæmorrhage becomes imminent. Again, a deeply-seated abscess in the neck or groin may eat its way into a large vessel, and cause serious, nay, even fatal, bleeding. The vasa vasorum of the outer coat dilate, and leucocytes infiltrate its substance. The fibrous tissue softens, swells up, and finally liquefies. Meanwhile the inner coat is involved; fibrin is deposited in the interlaminar spaces and on the free surface; and the endothelial lining is shed. Arteries below the size of the radial do not often rupture, for thrombosis precedes the destruction of the intima; but in larger vessels the blood-stream is strong enough to prevent coagulation in the continuity or to plough up a disintegrating clot in the ligatured end. The splenic, or other artery adjacent to the stomach, may be opened by an ulcer spreading from that organ.

In infective or ulcerative endocarditis, the inner coat of the aorta is sometimes eroded, partly from the friction of a retroverted calcified valve, partly from extension of the inflammation. In the same disease vegetations are not infrequently detached from the valves, and being arrested in the peripheral arteries, they excite acute inflammatory softening, with aneurism or, more rarely, rupture, as a sequel. This is known as *embolic arteritis.* Simple non-infective embolism causes only thrombosis and obliterative endarteritis.

Acute Endarteritis.—This affection selects chiefly the aorta and large trunk arteries. Syphilis has been observed in connection with it, but whether as a cause or coincidence is uncertain. On laying open the artery, small roundish, soft elevations are seen, most of which vary in surface area from the size of a small pea to three or four times that magnitude. They are semi-translucent. In tint they are greyish-pink, or faintly yellow from incipient fatty degeneration; but even then they offer a striking contrast to the dead-white and buff-coloured patches of atheroma. The appearance, which is strongly suggestive of an eruptive disease, is as if gelatine had been sprinkled over the inner coat. Calcification rarely occurs. In the earlier stages the middle and outer coats present nothing abnormal, but later on they are somewhat swollen, especially the outer, for the vasa vasorum are dilated, and the outer coat is more permeable to fluid exudations than is the middle. Under the microscope the diseased structure is found to be thickly set with small round nucleated cells, which lie parallel to the lamellæ. These cells are apparently derived from segmentation of the subendothelial corpuscles, but possibly some are white blood-corpuscles, which have migrated from the lumen of the affected artery.

(B) *Chronic Arteritis.*—Two varieties will be described under this head. (*a*) Chronic deforming. (*b*) Syphilitic.

Chronic endarteritis (arteritis deformans—atheroma) is a disease incidental to age, being seldom entirely absent after middle life. At the same time there is ample proof that the essential morbid change is inflammatory in nature, and further that it is largely dependent on mechanical strain. The evidence on the latter point, both positive and negative, is very conclusive. In the first place, as shown by Moxon, the large arteries are those usually affected; and when the medium-sized ones are involved, the splenic, coronary, and cerebral, which, from their anatomical disposition, are subject to continuous or repeated strain, are most likely to suffer. Again, the resistance to the local circulation offered by contracted granular kidney induces atheroma of the renal artery. Granular gouty kidney is known to be associated with thickening of the walls of the capillaries and smaller systematic arteries—*arterio-capillary fibrosis*, as it is designated by Gull and Sutton. The adventitia of these arteries is overrun with a hyalin-fibroid material, the tunica muscularis is hypertrophied, and the lumen encroached upon. The obstruction thus engendered gives rise to hypertrophy of the left ventricle, and raises the tension in the larger arteries. Chronic endarteritis is a constant sequel, and apoplexy from rupture of cerebral vessels a frequent termination. This form of vascular disease is more common in men than in women, and among the latter those accustomed to hard manual labour show it most.

Where large arteries pass beneath tendinous expansions or over bones—e.g. the femoral as it goes through the opening in the adductor magnus, and the iliac as it quits the pelvis—there chronic inflammation of the inner coat is wont to develop. Although the morbid process is common enough in the systemic arteries, it is almost unknown in the pulmonary, except where the right side of the heart is hypertrophied from bronchitis and emphysema, or stenosis of the mitral orifice.

Morbid Anatomy.—Chronic endarteritis commences in the deeper portion of the internal coat. The increased bulk causes the intima to rise in the lumen of the artery, so that the general uniformity of surface is broken by irregular elevations which, for the most part, lie with their long axes in the course of the vessel. The direction of the patches is determined by the line of greatest strain. In the aorta it is very manifest, especially when contiguous patches have coalesced. The branches, where they come off from the main trunk, are very liable to invasion, and, by the lateral extension and fusion of isolated patches, ring-like elevations may come to encircle them. In the event of the new tissue undergoing cicatricial contraction, the vessel is constricted—it may be, to obliteration of its lumen.

The elevations before referred to, are, in the first instance, pale yellow and but slightly raised. In the course of growth they assume a grey semi-translucent appearance, and frequently reach a tenth of an inch in thickness. To the feel they are inelastic, quite firm, or even of cartilaginous density. As yet they are smooth on the surface, the endothelial covering being retained. Sooner or later the patches turn yellow in the centre, owing to fatty degeneration of the inflammatory deposit, for there is no formation of blood-vessels in the new tissue. At the same time their consistence is diminished—it may be, even to fluidity. The cavity holding the softened débris is called an '*atheromatous abscess*'; the term, however, is a misnomer, for under the microscope the contents are found to be composed of fat molecules and their derivatives, cholesterine and stearic acid, the former appearing in the form of plates, the latter as acicular crystals. On rupture of the pellicle bounding the 'abscess' on its inner surface, the contents are washed out by the blood-stream and carried into the general circulation, but as the particles are very minute and non-infective, they do not usually give rise to symptoms.

The excavation thus made in the wall of the artery is termed an '*atheromatous ulcer*,' a name not warranted by the nature of the proximate lesion, which is degenerative, not suppurative. There is now opened up the possibility of formation of a dissecting aneurism, but such an event is rare, for the antecedent inflammation has served to weld together the middle and outer coats and the several lamellæ of each. Except in cases where the adventitia is little developed, as in the arteries of the brain, and the intrapericardial portion of the aorta, rupture is not to be anticipated, for the neoplasia in the outer coat is not subject to fatty softening; moreover, as the perivascular tissue is condensed, and adherent to the wall of the artery, an additional safeguard is furnished.

But the formation of an 'atheromatous abscess' is not a necessary sequel to fatty disintegration of the inflammatory overgrowth. The products of degeneration may remain as a cheesy pulp—hence the name *atheroma*, which is commonly used, however, to indicate the entire disease—or be converted into calcareous plates by the deposition of lime-salts, a process sometimes referred to as '*ossification*,' although there is no production of true bone.

The morbid change which begins in the inner coat implicates, sooner or later, the middle and outer; elasticity and contractility are lost, and the vessel is converted into a thickened, rigid tube. Atheromatous arteries are generally dilated and elongated, for, having lost their power of recoil, they yield before the distensile force of the heart. By reason of their elongation they are thrown into permanent curves, a fact that should be borne in mind during the operation of ligature, especially of the external iliac, which often dips into the pelvis. The rigidity and curvature explain the 'locomotive pulse.' The above-mentioned alterations in structure and appearance are aptly expressed by the term 'endarteritis deformans.' Atheromatous softening and calcification of the inflammatory deposit are inversely proportionate to the smallness of the vessel. In the arteries of the brain, for example, although the muscular coat is frequently calcified, and the outer greatly thickened by fibroid overgrowth, caseation of the intima is much less marked than in the aorta and other large arteries, where rapid breaking down and cretification of the new formation are constant.

Microscopy of Chronic Endarteritis.—The deeper part of the internal coat is infiltrated with rows of small round cells lying parallel to the lamellæ. The lamellæ themselves swell up and become indistinct, whilst they are evidently thickened by fresh fibrinous deposit. As the disease advances, the muscular layer is involved and its contractile cells are destroyed. Neither does the adventitia escape, but the process here is mainly or entirely plastic. The proportion of cellular and homogeneous deposit varies considerably, but the latter is generally in excess. As the new growth loses its vitality it disintegrates through fatty degeneration. The cells become granular and break up into molecular débris, which then calcifies or undergoes complete liquefaction. In the latter event cholesterine forms and crystallises out as thin plates. If a calcified patch be treated with dilute hydrochloric acid, and the residue examined under the microscope, it will be seen to consist of amorphous granules and fragments of glassy or faintly fibrillated tissue.

Results of Chronic Endarteritis.—(1) Thrombosis and embolism. (2) Narrowing and occlusion of branches. (3) Aneurism.

(1) *Thrombosis and Embolism.*—Thrombosis is apt to occur about calcified plates, which, having broken away at their edges, act as foreign bodies, and offer resistance to the flow of blood (*see* Thrombosis). Embolism may have its origin in the detachment of calcareous splinters, or of thrombi formed in the artery. Gangrene at the part supplied by the embolised or thrombosed vessel is to be feared.

(2) *Narrowing and occlusion of branches.*—One or more of three factors is concerned. (*a*) Encroachment on the lumen of the swollen intima. (*b*) Contraction of plastic lymph in the adventitia. (*c*) Pressure of an aneurism of the parent vessel. Obliteration is completed by thrombosis.

(3) *Aneurism.*—Chronic endarteritis is a fertile source of aneurism. Although the walls of an artery may be greatly thickened, their power of resistance is diminished, from loss of elasticity. Rupture of an 'atheromatous abscess' does not materially weaken the artery at that point, but it allows the full force of the blood-stream to act over a wider area of softened tissue. *See* Aneurism.

Syphilitic Arteritis.—How far syphilis is directly accountable for disease of the large arteries is a debated point. Aitken believes that it is a common cause of chronic arteritis, and certainly the fact that most of the cases of pathological aneurism in young subjects have a history of syphilitic taint lends weight to this opinion. It cannot be doubted that the virus of syphilis lowers the vitality of the coats of the arteries, as it does that of other tissues, and in this way it may lead to premature decay, and so predispose to inflammatory lesion. Syphilitic disease of the cerebral arteries is a not infrequent cause of thrombosis. It occurs in the shape of gummatous deposit in the outer coat and perivascular sheath; and as a proliferating change in the intima (Heubner), one or other form predominating. Arteries so affected look like dull-white threads or cords, and on examination are found to be much more solid than natural. It is easy to see how the swelling within the vessel, and the pressure without, must narrow the lumen, and obstruct the blood-current.

Barlow has described profound changes in the cerebral arteries of children suffering from congenital syphilis, of the same kind as those recorded by Heubner in the acquired disease. The new growth in the inner coat of the artery is made up of large nucleated cells. All the coats are involved, but the principal change takes place in the intima.

Periarteritis, or inflammation of the outer coat and areolar sheath, occurs under the following forms:—(1) Gummatous exudation into the lymphatic sheaths of the cerebral arteries. (2) Ulceration of a branch of the pulmonary artery skirting a phthisical cavity. (3) Arteritis by spreading of the inflammation from surrounding tissues, as when an artery becomes involved in periphlebitis, or in deep-seated suppuration.

Periarteritis may end in resolution, without local consequences; but there is danger of thrombosis, aneurismal dilatation, and rupture.

II. Degeneration.—(*a*) Fatty degeneration has already been mentioned in connection with atheroma, where it constitutes an essential part of the morbid process, giving rise to softening and disintegration of the new formation. In this case it is secondary to inflammation. But it occurs widely distributed as a primary change. Thus, in the large arteries, especially the aorta, it affects the stellate subendothelial corpuscles of the intima. It here appears as bright yellow spots or streaks, slightly raised above the surface, and smooth or finely downy. The deeper structures remain intact. It is found at all ages, even in very young children. It is of no clinical significance.

Of far graver import is the fatty degeneration so constantly met with in the cerebral vessels late in life. The adventitia receives the brunt of the mischief, but fat-molecules may be observed scattered through all the coats. As the result of softening, the small arteries burst under the blood-pressure.

In disused or paralysed limbs, the arteries show fatty degeneration of the contractile fibre-cells of the middle coat, and of the connective-tissue corpuscles of the inner and outer.

(*b*) *Calcification* is an important feature in chronic endarteritis, where, as before said, calcareous plates are the abiding mark of previous inflammation and softening. Primary calcification is very common in the medium-sized arteries—e.g. the cerebrals and tibials—of old people, or in those where the middle coat is well developed. Lime-salts are deposited first in the muscular fibre-cells; and, as these lie athwart the vessel, there results a series of streaks or rings which encircle it—*annular calcification.* By lateral extension these rings join and form a rigid cylinder—*tubular calcification.* The process is not confined to the middle coat, for it extends to the others, causing great irregularity and roughness.

The lumen of the artery is diminished. There is a great tendency to bilateral symmetry. The affected vessels, where superficial, can be felt as incompressible cords.

(*c*) *Amyloid degeneration* of the small arteries can be seen in tissues and organs affected with albuminoid disease. It conduces to hæmorrhage, and thus becomes of surgical interest.

III. Atrophy of Arteries forms a part of general and local wasting. According to Virchow, all the vessels are atrophied in chlorosis. If the femoral artery be ligatured for popliteal aneurism, the portion between the ligature and the aneurism, although not obliterated, shrinks to less than half its normal dimensions. The lumen is narrowed, and the coats are reduced in thickness.

IV. Hypertrophy of Arteries.—True hypertrophy occurs in the collateral branches after ligature of the main trunk. The walls are thinner than natural, owing to the dilatation consequent on the rise in the blood-pressure, but still the bulk is increased.

The small arteries are hypertrophied in granular kidney.

V. Raynaud's Disease.—Local asphyxia or symmetrical gangrene, are names given to phenomena which arise out of disturbance of the nervo-muscular dynamism of the small and medium-sized arteries. The subjects of this disturbance are not uncommonly young children, hence the expression *gangrène juvenile,* to indicate one of the pathological accidents of the disease. The fingers, toes, nose, and ears are the parts mostly implicated. The skin is cold, and sometimes cyanosed—*local asphyxia.* At others it is pale and marble-like—*local syncope.* The arteries are not diseased, but together with the capillaries and small veins they are subject to severe and prolonged spasm. The difficulty of the circulation may be so great as to cause gangrene.

As concomitants we may mention the occasional occurrence of erythematous eruption on the skin on different parts of the body, and renal hæmorrhage. The excitability of the vaso-motor centres in the spinal cord is exaggerated, and the irritability of the sensory nerves is increased.

VI. Arterial Embolism has been noticed under 'embolic arteritis' and 'atheroma.' The following are its sources :—

(1) Vegetations, simple or infective, detached from the cardiac valves. (2) Blood-clot dislodged from an aneurismal sac, or from an atheromatous artery. (3) Calcareous plates from the large arteries. (4) Portions of a new growth which has invaded an artery. (5) Venous thrombi in the case of the pulmonary artery.

The results are according to the size and nature of the embolus, and the state of the collateral vessels; thus embolism of the pulmonary artery may be suddenly fatal; embolism of the tibials may lead to secondary thrombosis and gangrene; infective embolism may give rise to aneurism, or, less probably, rupture.

VII. Arterial Thrombosis.—The blood may coagulate in the arteries from (1) Laceration of the coats, as in ligature.

(2) Embolic plugging (*see supra*). (3) Continued spastic contraction (see *Raynaud's disease*, above). (4) Hyperinosis, coupled with cardiac failure, as in the case of an acute fever. (5) Disease of the vessel, e.g. syphilitic arteritis and atheroma. Diffuse thrombosis of the tibial arteries is one cause of senile gangrene. Diffuse thrombosis of a large artery—e.g. the femoral—is usually followed by a similar process in the companion vein; gangrene is then inevitable.

VIII. TUMOURS.—Tubercle is never seen in the walls of arteries, although the perivascular tissue is one of its favourite sites. Malignant tumours occasionally invade an artery, and project into the lumen; but it is surprising how long this is resisted. Syphilitic gummata are found in connection with the cerebral arteries, but strictly speaking they are not new growths.

AUGUSTUS J. PEPPER.

ARTERIES, Rupture of.—An artery may be ruptured partially or entirely; and either subcutaneously or in an open wound.

Partial Rupture.—In this injury it is the internal, or rather the internal and middle coats that give way.

Instances of partial rupture are met with—(1) In the operation of ligation of an artery. (2) From sudden strain, e.g. during an attempt at reduction of an old dislocation, especially of the shoulder-joint. (3) In crushing of a limb, the vessel being ground against the underlying bone. (4) From the application of violent external constriction combined with traction, as in judicial hanging.

The disposition of the inner and middle coats at the seat of laceration will vary according to the presence or absence of disease of the vessel, and the mode of injury. In simple ligature of a healthy artery the coats are as cleanly divided as though they had been cut with a knife, both in the living and dead subject. At the same time there is very little gaping, and no curling up within the lumen of the vessel, since the tendency of the inner to recoil with the middle coat is insufficient to tear it from its connection with the outer. But when the force employed crushes or twists the artery, the inner coat is raised from its bed, and by virtue of its elasticity it retracts and become rolled upon itself, at the same time that it is drawn inwards by the circular fibres of the muscular coat. Thus a flap-like valve is formed, which arrests or obstructs the current of blood, exactly as happens in torsion.

In chronic disease of an artery the inner coat loses its elasticity, and the middle its contractility, through fatty and calcareous degeneration, whilst all three coats are frequently so blended by fibroid overgrowth as to be practically inseparable. On the other hand the injury may light upon a patch of softening, and tearing through its inner wall lay the foundation of dissecting or other form of aneurism.

The results of Partial Rupture are (1) thrombosis; (2) gangrene; (3) aneurismal dilatation; (4) subsequent complete rupture. Partial rupture, *per se*, usually ends in thrombosis and permanent occlusion, as in ligation; but, as stated above, gangrene may ensue from the combined effects of obstruction in the main artery and the pressure of blood extravasated from a number of smaller vessels. Wide-spread arterial disease conduces to a like result, the rigid anastomosing arteries not dilating in time for the collateral circulation to be established.

Diagnosis of Partial Rupture, when the vessel is comparatively superficial, as it commonly is:—(1) Look for arrested or diminished pulsation in the arteries on the distal side of the seat of injury; (2) examine for a small, more or less firm, circumscribed swelling below where the artery continues to beat; (3) ascertain if the difficulty in the circulation is greater than can be accounted for by the extravasation of blood from small vessels in the muscles and cellular planes of the limb.

Treatment.—Wrap the limb in cotton wool, place it upon a pillow, between sandbags, in a semiflexed and slightly elevated position. Bandages had better be dispensed with, on account of the danger of still further embarrassing the circulation. If gangrene supervenes amputation must be resorted to. If the rupture becomes complete later on, the treatment will be as hereafter advised.

Complete Rupture may occur by avulsion of a limb. The bleeding under these circumstances is less than might be expected, for the internal and middle coats are torn from the outer, and contracting and retracting curl up within the vessel; and the outer coat and the sheath of the artery are folded or twisted over them. Hæmostasis is furthered and may be completed by the formation of a clot. The rupture is termed complete, when the wall of the artery is torn through in one part or throughout its whole circumference. In either case it may take place subcutaneously, or accompany a lacerated wound of the soft parts. It may be complicated, amongst other accidents, by simple or compound fracture.

Subcutaneous Rupture without fracture.—The arteries most commonly injured are the popliteal and the axillary; the former from a violent wrench of the leg, the latter during the attempt to reduce an old luxation of the shoulder-joint. The disaster is immediately followed by severe pain in the part, and this by numbness of the limb, which as a rule the patient is unable to use to any extent. The latter symptom, however, is not constant, either as regards its onset or degree. Pulsation ceases or is much weakened in the arteries beyond, the exact issue turning upon the amount of extravasation, and whether the rupture has involved the entire vessel or only a segment of it. The limb is colder than its fellow, the temperature rapidly falling. Blood escapes from the rent and collects around the artery, forming a tense swelling, or it is driven far and wide among the surrounding tissues; the result varying according to the size of the vessel, the size of the opening in it, and the resistance offered by adjacent structures. Pulsation is mostly absent, and when present it is generally over a limited area. Possibly a loud or subdued bruit may be heard, but it is not conducted along the course of the artery with the same frequency and distinctness as when generated in a pathological aneurism.

Treatment.—The surgeon will be partly guided by the condition of the limb as to the amount of bruising and extravasation. If gangrene has set in, amputation must be performed at once. The liability to gangrene is more remote in the upper than in the lower extremity, and the possession of the arm more essential to the patient than the leg; hence, every attempt should be made to save it. If in rupture of the brachial, radial, or ulnar artery, the extravasation has ceased and is not very extensive, compression should be applied at the seat of injury and over the main vessel higher up.

Under opposite conditions, and also in cases where the diagnosis is doubtful, it will be safer to cut down, turn out the clot, and ligature the artery on each side of the opening in it. The limb should be raised to empty the vessels, and then Esmarch's cord be applied. If difficulty is experienced in finding the ends of the vessel, the tourniquet should be loosened, to allow a jet of blood to escape; or a little dissection made in the course of the artery.

Rupture of the main artery in the lower limb generally calls for primary amputation, but if gangrene has not commenced, and the soft parts are not too extensively damaged, double ligature should be resorted to in the first instance, especially when the patient is young and the vessels presumably free from disease. AUGUSTUS J. PEPPER.

ARTERIES, Wounds of.—When hæmorrhage is severe, it is generally found that its source is a wounded artery. A vessel may be completely or only partially divided. In the latter case the damage may consist in the artery being split, or in a transverse cut involving a part only of its circumference. Notwithstanding the comparative rareness of these partial divisions, they are of extreme interest to the surgeon, as furnishing a considerable contingent of cases of persistent recurrent bleeding. The explanation as to why the hæmorrhage is so persistent in such cases is to be sought in the anatomical structure of an artery, and by consideration of the process by which nature arrests the hæmorrhage of a completely divided vessel; for if it be remembered how important the contraction and retraction of the vessel are in arresting the hæmorrhage in such a case, it will be seen that the same mechanism causes the opening to gape and remain patent when the vessel is only partly divided. If it be known that a vessel is only partly divided, its division should be made complete, and its ends ligatured.

The details of the treatment of wounded arteries are described under the headings of the special vessels; but, before considering these, it may be well to discuss briefly the general principles on which the treatment of arterial hæmorrhage is conducted, the treatment, in great measure, depending on whether the hæmorrhage occurs from an incised or a punctured wound.

TREATMENT OF ARTERIAL BLEEDING IN INCISED WOUNDS.—Bleeding vessels should always, if possible, be secured *in situ*. As a rule there is little difficulty in picking up the bleeding artery. Occasionally, however, owing to the bleeding artery lying deeply in the angle or apex of the wound, it cannot be readily secured with the forceps, or it sometimes happens that, owing to the vessel having retracted, the bleeding point itself cannot be seen. In these circumstances a little careful enlargement of the wound, in the direction of the bleeding, will enable the vessel to be secured. Occasionally, especially in wounds of the scalp, it is a better practice to treat the retracting vessel by pressure, or by a harelip pin passed beneath it, than to make anything like a cross-cut to search for it.

A few years back several methods were advocated for securing divided arteries: thus, in preference to the ligature, some surgeons advocated various forms of acupressure or torsion. The advantage of these consisted in avoiding the septic track caused by the ligatures, the ends of which were always allowed to hang out of the wound. Since the introduction of the catgut ligature, which, after the ends are cut off, is left in the wound, such objections have entirely disappeared, and ligatures either of gut, tendon, or Chinese silk, are almost universally employed, and are, by far, the simplest and surest agents for closing the vessels. In some rare cases in which a diseased vessel will not hold a ligature, acupressure may still be usefully employed.

The surgeon, on being sent for to a case of hæmorrhage from an incised wound, will generally find the part wrapped round with handkerchiefs or towels partially soaked with blood. Before removing these, which may have served temporarily to restrain the bleeding, the patient should be gently lifted on to the edge of a bed or couch in a good light. This matter of light is of the utmost importance, making all the difference between success and failure in picking up the vessels. Should the wound be on one of the limbs, a tourniquet, or the finger of an assistant, must be placed in readiness over the main vessel—the femoral or subclavian as the case may be—but pressure is not exercised until required. A basin, a sponge, and cold water being placed handy, all wrappings are rapidly removed from the wound. All clot must be cleanly sponged out, and any vessels that can be seen to be divided, whether bleeding or not, should be tied. If alarming bleeding well up from a main vessel at the bottom of the wound, the finger must be placed over the bleeding point, when a little dissection, with the back of a knife or director, will bring the vessel into view above and below the bleeding point, and two ligatures can be applied with an aneurism-needle. When the bleeding has been arrested, the edges may be brought together in the usual manner.

TREATMENT OF ARTERIAL BLEEDING FROM PUNCTURED WOUNDS.—Straightforward and easy as may be the treatment of hæmorrhage from incised wounds, the course to be adopted for the arrest of arterial bleeding from punctured wounds forms a grave and complicated question.

The writer believes that the arbitrary rule, that 'in every instance the wound should at all hazards be laid open, and the vessel secured at the bleeding point,' is far too dogmatic, and has led to severe and even fatal operations, many of which were wholly unnecessary.

Without doubt the general acceptance of the principle of searching for the wounded artery has been due to the writings of Guthrie, who in forcible language taught it, to the exclusion of all other forms of treatment. His teaching quickly permeated medical literature, and it soon came to be considered that the surgeon who failed thus promptly 'to look his enemy in the face,' showed timidity, or a want of knowledge in the first principles of his profession.

Surgeons who have performed or witnessed the operation necessary for the securing of the tibial, deeply situated in a punctured wound, will know that Guthrie's description of the ease and certainty of this operation is not merely inaccurate, but misleading, as entirely opposed to the actual facts. Thus Arnott, in his well-known case of ligature of the tibial in a punctured wound, says: 'It is not an operation that should be undertaken inconsiderately, for it requires a good light and intelligent assistance. The case described occurred in the day-time, and from what was experienced I am inclined to think that it could not have been successfully performed under artificial light.'

So eminent a surgeon as Dupuytren readily recognised that the search for wounded vessels deeply situated in a muscular calf was a procedure surrounded by practical difficulties, for, says that author, 'to all who know the depth of these vessels, their relations to the bones, nerves, and muscles, the scheme of cutting down upon the vessels appears impracticable. How could they be distinguished from the soft torn bruised parts which surround them, or how could a ligature be passed and tied at the bottom of a wound deep between the bones?'

It is often argued that, because the treatment of hæmorrhage from an incised wound is so easy, and that from a punctured one so complicated, by converting the one into the other all difficulties will disappear. The fallacy of the assumption that in all cases the characteristics of an incised wound can be given to a punctured one by its mere enlargement, becomes obvious on reflection.

Punctured wounds must of necessity be inflicted by small missiles or narrow instruments, which can penetrate to positions inaccessible by a simple incision. Their direction and depth are often quite unknown, consequently the position and size of the bleeding vessel is a matter of mere speculation. The bleeding point may be, and often is, far away from the external wound, possibly on the opposite side of the limb, so that a very deep and extensive incision has to be inflicted to secure what may ultimately prove to be an unimportant arterial twig. If, of course, it could be shown that by enlarging the wound the vessel could be secured with little difficulty or risk, while on the other hand, similar forms of treatment commonly resulted in failure, the cutting down doctrine might be accepted in its entirety. Experience, however, leads to an opposite conclusion, and shows that not only the search for the wounded vessel at times proves ineffectual, but that all bleeding might have been permanently arrested without the necessity of any operation.

Guthrie's rule for the treatment of arterial hæmorrhage has purposely been criticised, but it must not be inferred that this plan is never applicable. A wound may be so situated, or the limb in such a condition, that it becomes the safest and most practicable method; but it is specially urged in this article, that the surgeon will best consult the interest of his patient who remembers that the procedure is not to be regarded as a trifling one. For however simple and easy it may be at times, it at others involves a hazardous operation, not to be undertaken without a full conviction of its necessity.

If the surgeon requires any rule, it should rather be that in punctured wounds, unless the exact source of the bleeding is obvious, the careful and even application of pressure should be first tried, reserving active operative interference until so simple a procedure as pressure has proved ineffectual. The surgeon must not allow his judgment to be warped by fear of the failure of the pressure which he employs, and the possibility that he may have to fall back too late on the cutting plan; but he must consider what on the whole is the simplest treatment, and that which is most likely to be successful with the least risk to his patient. The details of treatment will vary according to the locality of the particular artery injured, and are fully considered under the headings of the various vessels. But it may be well before discussing these to consider the general plan of treatment.

Treatment.—The surgeon is hurriedly sent for to a patient who is said to be bleeding to death from a punctured wound. On arrival it will generally be found that natural alarm at the sight of blood has led to the extent of the bleeding being greatly exaggerated, 'the torrents of blood' often meaning but a few ounces. The state of the patient's pulse and his general appearance will usually afford a safe basis for the estimate of the extent of the bleeding; moreover, the effect produced upon the patient is more important than the actual quantity of blood lost. If the collapse be not severe the patient should be at once lifted upon a convenient couch or bed. This should be done with the greatest care and gentleness, the patient being kept in the recumbent position, and on no account allowed to make the least muscular exertion. Bearing in mind what has been stated elsewhere as to nature's process of stopping hæmorrhage, it will be understood that it is of the utmost importance to prevent the blood-coagulum, which has very probably temporarily formed during the period of collapse, from being again broken up by the force of the heart's action—a risk incurred by any exertion on the part of the patient. *See* HÆMORRHAGE.

The cloths and bandages generally found wrapped round the wound must be removed in a good light. The next steps to be taken will depend on whether the bleeding has ceased or is still continuing.

TREATMENT WHEN THE BLEEDING HAS CEASED.—The parts in the neighbourhood of the wound can be gently cleansed of blood with a soft sponge and warm water. But the clot itself seen in the wound should on no account be disturbed, the orifice being simply covered with a couple of folds of lint wetted in cold water or carbolic lotion. The patient should be lightly covered with blankets, in such a way that the wound covered by the lint is exposed, so that any recurrence of bleeding can be at once detected. It is better in these cases, where the bleeding has actually ceased, to apply no pressure, either directly on the wound or indirectly on the course of the vessels, for fear of disturbing the arresting clot.

The clothes if dry may be simply loosened; otherwise they must be cut off, clumsy attempts to remove them being often followed by a fresh bleeding. There is no period when the most absolute rest is so necessary as in the first few hours after a severe bleeding which has spontaneously ceased, for the coagulum that has formed during the collapse is constantly growing stronger by extension within the vessel, and, if time be allowed, will form an effectual barrier before reaction occurs. This rest, so imperative at first, must be enforced, though not perhaps quite so rigidly, for several days, and the patient should, on no account, be allowed to leave his bed till the external wound is soundly healed. Want of precaution in this respect is a common cause of traumatic aneurism, unnecessary intra-arterial pressure being put on the sealed end of the vessel before it is sufficiently consolidated to stand it.

Treatment when the Bleeding is continuing.—If the wound be situated in one of the limbs the bleeding must be at once controlled by pressure, either digitally or by the tourniquet on the main artery. In the upper extremity the brachial can be compressed against the middle of the humerus, if the wound be in the forearm or hand. If the bleeding come from a higher point, the subclavian must be compressed. In compressing the subclavian the finger or thumb cannot be relied on except for a short time, a piece of wood or a small poker, covered with lint, being far more effectual.

The femoral artery is best controlled as it crosses immediately beneath Poupart's ligament, its course in this situation lying midway between the symphysis and the anterior superior spine. The mistake very commonly made is that of applying pressure an inch or two below the ligament, a position in which much more force is required to control the vessel than need be applied at a higher point.

The bleeding having been thus temporarily controlled, time is gained for considering the best course to be pursued for its permanent arrest. If the wound is known not to be deep, from the nature of the instrument inflicting it, and moreover, if it is situated over the main vessel of a limb where that vessel is naturally superficial, as in Scarpa's triangle, or along the course of the brachial, or in a position such as in the middle of the neck, where effectual pressure is impracticable, the wound may be enlarged, and the vessel sought for at the injured point.

On the other hand, if the wound be of unknown depth, and in a position in which the main vessels are deeply situated, as in the lower half of the thigh, the calf, the forearm, and the hand, pressure should certainly be tried before resorting to an operation.

Method of employing Pressure.—In order that pressure may be successful in permanently restraining the bleeding it is well to bear in mind the following points:—

1. That blood may be furnished at either end of the divided artery.

2. That pressure is not only required over the wound, but along the course of the artery, both above and below it.

3. The pressure must never be entirely concentrated at a single point, but disseminated along the course of the vessels, for, by distributing the pressure, much less is required to arrest the bleeding than if it be applied on the wound alone.

4. That the whole quantity of blood circulating in the limb can be lessened by careful bandaging from below upwards.

The methods of applying pressure require modification in particular situations, and will be found under the headings of the different vessels. But the following is the general principle.

The bleeding being temporarily arrested by the tourniquet, the wound must be gently washed and sponged as dry as possible. A conical pad, made of from sixty to eighty separate pieces of lint, the smallest the size of a sixpenny bit, the largest an inch and a half in diameter, is applied directly over the wound, and kept in position by two narrow pieces of X strapping. The limb is then very evenly bandaged with a domette roller from the toes or fingers upwards as high as the conical pad. The pad being left uncovered, the bandage is continued upwards to the shoulder or groin, ending off with a spica. Two compresses, prepared by winding strips of lint round a firm foundation, such as the half of a pencil or penholder, are now laid along the course of the main vessel, both above and below the wounded point. These roller-like compresses must be firmly applied and kept in position by separate bandages. Lastly, another narrow bandage is wound round the limb over the conical pad, to exert pressure upon it.

It is a good plan in some situations to have a broad, well-padded splint on the side of the limb opposite to the rollers and pad, so that the bandages which keep them in position do not exert a circular pressure entirely round the limb.

There is great advantage in having the rollers and pad kept in place by three distinct bandages. By this arrangement any one of them may be loosened or tightened, as the case requires, without disturbing the others, which is a matter of considerable importance. The next question which arises is as to the length of time the pressure should be employed.

So long as the circulation has been fairly carried on in the limb—a point easily ascertained by momentarily compressing the capillaries of the toes or fingers—pressure can be maintained without risk of gangrene. It is very desirable to keep up a moderate amount of compression for a considerable period—an object to be attained by taking great care that it be not too much concentrated at any single point, for, if a bandage be too tight at any spot, not only will it cause pain and restlessness, but it is liable to produce sloughing of the skin. If possible, the firm pressure first applied should be maintained for eight or twelve hours. If pain or discomfort be then complained of, a judicious snip of the bandage here and there at any points which appear to be too tight will give relief. In this way a diminishing amount of pressure can be maintained for several days. Speaking generally, in primary hæmorrhage, if the bleeding has been arrested for twelve hours, the clot within the vessel will have acquired sufficient consistency to prevent its recurrence. During the treatment absolute rest in bed is essential, and the limb should be raised on pillows to a comfortable height.

Occasionally, notwithstanding every precaution and care in the trial of pressure, hæmorrhage will recur. In these circumstances it is possibly due to the premature slipping of one of the pads or bandages, so that it would be right to give it one more trial before abandoning it as useless. Should this second attempt fail, or the limb be in such a condition as to forbid a second trial, the wound should be enlarged and the bleeding-point sought for, with the exception of wounds in a few localities to be described.

Search for the Wounded Vessel.—The patient, under an anæsthetic, being placed in a good light—a matter of the utmost importance—the surgeon passes his left forefinger into the wound, and, if necessary, enlarges the orifice with a probe-pointed knife sufficiently for the purpose. By a little manipulation it can be ascertained when the point of the finger controls the hæmorrhage. A straight probe-pointed knife is then passed down by the side of the finger, and the wound boldly enlarged to a sufficient extent both upwards and downwards. The length of the incision thus made will depend on the depth of the wounded artery, and may have to be six or seven inches in length. The cut must always be made in the line of the limb, a transverse or T cut being, if possible, avoided. Cross-cuts seriously interfere with the vitality of the margins of the wound, and, if extensive, may even imperil the limb itself, from the severance of the collateral circulation.

Harrison Cripps.

ARTERIOTOMY.

—The operation, now rarely performed, of opening an artery for the purpose of general blood-letting. The trunk of the temporal artery as it crosses the zygoma, or its anterior branch as it passes on to the forehead, are ordinarily the only vessels suitable. In consequence of the extreme ease with which pressure can be applied over it, the anterior branch should be selected, unless it is abnormally small.

Apparatus required.—Lancet or small scalpel, graduated bleeding-bowl, firm compress of lint, narrow bandage, water and sponge.

Operation.—The vessel having been fixed by placing the finger or thumb on it a little to the distal side of the spot selected for the incision, should be cut down upon and laid open transversely until it has been about half-divided; the necessary amount of blood having been taken, as shown by the graduations on the bleeding-basin, the artery should be completely cut across, the compress applied and retained in position by the bandage. At the end of forty-eight hours strapping may be substituted for the bandage, but the compress itself must not be disturbed till the fourth or fifth day, when the wound should be healed. The complete division of the vessel before the application of the pad is important, in order to more certainly avoid (1) secondary hæmorrhage, and (2) consecutive aneurism. William H. Bennett.

ARTERIO-VENOUS ANEURISM.

Under this term are included all cases of abnormal communication between an artery and a vein.

1. *Causes.*—Arterio-venous aneurism is generally traumatic in origin, and the most frequent cause has been phlebotomy; next in order of frequency is gunshot injury, and then stabs and similar punctured wounds. In one case prolonged compression of the femoral artery for the cure of an aneurism on the posterior tibial trunk was followed, ten months later, by an arterio-venous aneurism at the point of compression. In other cases, also, the aneurism has only developed at a long interval after an injury—even as much as twelve or even thirty years. There is another group of cases in which the abnormal communication has occurred spontaneously without any previous injury; many of these are to be regarded as instances of the rupture of an aneurism into an adjacent vein. Since venæsection has become a comparatively rare operation, and always entrusted to skilled hands, this form of disease has

become much less common. It is met with in connection with small arteries and veins, such as the branches of the sciatic vessels in the great sciatic nerve; medium-sized vessels, such as the temporal, occipital, and posterior tibial; or large vessels, as the popliteal, femoral, iliac, brachial, carotid, and even the aorta itself.

2. *Pathology.*—The arterio-venous communication is generally between vessels lying closely side by side; but this is not always the case. At the elbow, for instance, the communication is commonly between the median-basilic vein and the brachial artery; in the neck, arterio-venous aneurism of the external carotid artery and the internal jugular vein has been observed. According to the character of the arterio-venous communication cases of this disease have been divided into two classes, and the division is of much practical importance. Where the two affected vessels are firmly adherent together, with a large or small aperture through the walls where they are in close contact, and the blood passes directly from the artery to the vein, the condition is known as *aneurismal varix*, for the aneurismal tumour which is produced is, in fact, a dilated vein. In many other cases, however, there is a consecutive or a spontaneous aneurism developed in connection with the artery, which also communicates with a vein, and the condition is then known as *varicose aneurism*, the important feature of the case being the existence of a veritable aneurism. In *aneurismal varix* the aperture of communication between the artery and vein may in recent cases be slit-like, but in old cases it becomes rounded, with smooth, thickened edges. The artery above and below the aperture is considerably dilated, and its walls are thinned.

In some cases these changes have been most marked above the communication, and the vessel below has been described as contracted, while other observers have described the arterial changes as most marked on the distal side of the aperture into the vein; these changes may be met with at a considerable distance from the original lesion. The vein becomes greatly distended and pouched immediately opposite the opening into the artery, and its walls become thickened; these changes affect the veins for some distance, especially on the cardiac side of the arterial aperture, and they are not limited to the trunk immediately affected, but involve also the branches opening into it. Thus, in an aneurismal varix of the femoral vessels at the groin, the superficial epigastric, circumflex iliac, and external pudic veins were enlarged, as well as the femoral and internal saphenous trunks. In *varicose aneurism* the condition of the affected arteries and veins is the same as in aneurismal varix. In addition there is an aneurism. Where the aneurism is 'consecutive' or traumatic in origin it is usually of small size. In the cases of spontaneous aneurism with communication with a vein the tumour has generally attained a large size before it has, by the influence of continuous pressure, caused absorption of the wall of the vein. The openings of the artery and the vein into the aneurism vary in size and in relative position, sometimes being on opposite sides of the sac and at others close together. The sac of the aneurism contains only a small amount of laminated fibrin, even if any be present.

3. *Symptoms and Diagnosis.* — The symptoms common to all cases of arterio-venous aneurism are (1) the presence of a tumour with expansile pulsation synchronous with the action of the heart; (2) distension of the veins of the part on both the distal and the proximal side of the swelling; (3) a very marked purring or rasping thrill, which is felt at its greatest intensity over the arterio-venous communication, but is conducted for some considerable distance along the veins of the part. This thrill is continuous over the 'aneurism,' but is exaggerated by each cardiac systole; in the veins at some distance from the tumour it may be intermittent and systolic only. (4) A loud buzzing, hissing, or rattling murmur, heard loudest over the aperture in the vein, where it is continuous, but accentuated at each beat of the heart; the bruit is conducted for some distance along the distended veins, gradually becoming weaker and systolic only. This murmur may be audible to the patient and even to the bystanders, and, heard through a stethoscope, it may be of painful intensity. In addition, there is sometimes a soft blowing aneurismal murmur. Pressure over the swelling, just where the thrill and bruit are most marked, may abolish the thrill, and greatly lessen or abolish altogether the loud bruit, and these effects are believed to be due to the pressure being applied so as to close the opening into the vein. There may be severe pain from pressure upon the nerves of the part, or œdema from obstruction to the venous circulation. The peculiar thrill and murmur are the features which enable the surgeon at once to recognise an abnormal communication between an artery and a vein, and they are due to the passage of blood from the artery into the vein. If

the aneurism be deep, and the aperture into the vein be small, these signs may be absent, and the diagnosis be rendered impossible; and one case has been reported in which, from the small size of the artery involved, pulsation was not detected in the tumour.

The diagnosis between an aneurismal varix and a varicose aneurism may be impossible where the disease affects a deep vessel and the aneurism is small. Aneurismal varix is less formidable than a varicose aneurism, and its symptoms and the disturbance of the circulation it entails are less severe: it may remain stationary for many years, causing little inconvenience to the patient except the consciousness of the murmur and of the thrill. Varicose aneurism runs a more rapid course. If, when the artery leading to the swelling be compressed so as to arrest all pulsation, the swelling collapses completely without the application of any or of but very gentle compression, the affection is a varix; but if, on the contrary, when pulsation is thus arrested, the veins collapse, but a distinct tumour remains, which can only be emptied by compression, it indicates that there is an aneurism. Similarly in the cases where light pressure upon a particular spot stops the thrill and murmur, if it be found that by this means the swelling collapses, it is a varix; while, if there is still a swelling with expansile pulsation, it shows the case to be an aneurism. Where, in addition to the loud murmur characteristic of an opening into a vein, a soft systolic blowing bruit can be detected, it is strong evidence of the presence of an aneurism. This bruit may be only audible when the flow of blood into the vein is arrested by pressure over the aperture of communication. In some cases there is the history of a simple aneurism and the subsequent development of the characteristic thrill and bruit; in other cases, again, there is a history of an aneurismal varix becoming suddenly larger, more painful, and causing serious interruption to the circulation of the limb, from the formation of an aneurism. It is impossible to distinguish between these two affections in the orbit.

4. *Treatment.*—*Aneurismal varix*, as a rule, requires only palliative measures. The distended veins have thickened walls, which resist the force of the blood flowing into them from the artery, and after a while the swelling ceases to grow, and the patient is not exposed to the danger of its rupture. In such cases, external support by a bandage, or an elastic webbing made to fit the part, fulfils the indications for treatment. Should the varix be painful, or in any other way disable the patient, means for its cure may be adopted. Of the plans of treatment which have been suggested the best is the ligature of the artery above and below the communication with the vein: this operation is attended with unusual difficulty owing to the dilatation of both the artery and the affected vein.

In *varicose aneurism*, the existence of the aneurismal sac, with all the perils associated with that condition under other circumstances, necessitates curative treatment; and whether causing severe symptoms or not, so soon as the diagnosis of aneurism has been arrived at, careful attempts at its cure must be made. Several methods are open to the surgeon. Where by compression at one spot the characteristic thrill and bruit are lost, digital or instrumental compression of the main artery above should be combined with it; this sometimes proves quickly successful. Where it fails, or cannot be carried out, and the aneurism is on a limb, the patient may be anæsthetised, and an elastic bandage applied to the limb below and above the tumour sufficiently firmly to arrest the circulation completely. By this means the aneurism and the connected vessels are filled with stagnant blood: this alone may secure clotting, as in simple aneurism, or an electric current may be passed through the blood by means of needles inserted into the aneurism, or coagulants, such as perchloride of iron, may be injected into the sac. Electrolysis may be applied without previously arresting the circulation, but coagulants must never be injected unless this precaution have been taken.

Should coagulation be obtained by either of these means, the clot should be protected from the full force of the circulation by digital or instrumental compression of the main artery for two days at the least. When these measures fail, or cannot be carried out, an incision should be made over the tumour, in the line of the artery, and that vessel ligatured above and below the sac—if possible, without opening the aneurism. The application of a single ligature to the artery above the sac should not be practised in the limbs, as it has often failed to obtain a cure. In varicose aneurism of the orbit the proper treatment appears to be the ligature of the common carotid artery, and, should this fail to arrest the pulsation in the tumour, it should be followed by the direct application of electrolysis to the aneurism. *See* Orbital Aneurism.

A. Pearce Gould.

ARTERY-FORCEPS.—The object of an artery-forceps being to arrest hæmorrhage during an operation as rapidly as possible, it must necessarily be fitted with a spring or catch so as to hold its position when released by the surgeon's hand. The *serre-fine* or twisted wire of the French instrument-makers has never been a favourite with English surgeons, on account of its small size, but the larger metal clamp commonly known as the 'bull-dog' was formerly a good deal employed.

The *forci-pressure* forceps, introduced into practice by Sir Spencer Wells a few years back, has been largely adopted by operating surgeons, and has the great convenience that it is readily applied, and maintains its hold so thoroughly that, at the conclusion of the operation, the vessel is found to have been effectually occluded by the mere pressure; or, if not, it can be easily twisted with the same instrument, over which, also, a ligature can be tied if preferred. Köberle's forceps is practically identical.

For taking up arteries at the conclusion of an operation many surgeons prefer a pair of ordinary dissecting-forceps, by which the vessel is readily seized and drawn out of its sheath for the application of a ligature. But a ligature is not easily tied upon an artery held by such an instrument, since the blades are apt to be included in the knot.

Liston's artery-forceps, with expanded blades and sharp points, is a more generally useful instrument, and has the advantage of a spring-catch; but it is dangerous when applied too near a main trunk, which it may accidentally pierce, so as to give rise to further bleeding.

Asalini's forceps is kept closed by a spring, so that the pressure of the fingers is required to open it, and this must be again relaxed in order that the points may seize the vessel. A noose of ligature is usually placed around this forceps before it is applied, and is then slid down over the mouth of the vessel by those surgeons who employ it.

A *torsion-forceps* is made with broad serrated ends, and the blades are usually fitted with a sliding-button, by which they are approximated and held upon the artery to be twisted. There appears to be no reason why this inconvenient arrangement should not be replaced by a spring-catch, as in Syme's artery-forceps.

ARTHRITIS. *See* JOINTS, Diseases of.

ARTICULAR CARTILAGE, Diseases of.—The changes which originate in articular cartilage are mostly rather of the nature of degenerations than active disease; and inflammation of this structure is certainly, in most cases, secondary to affections of the synovial membrane, or of the joint-ends of the bones.

In acute inflammation of joints, especially of the septic variety, the articular cartilage often undergoes a rapid dissolution, which is undoubtedly due to the inflammatory disturbance of its nutrition. If such a joint be examined, it will be found that in addition to the swelling and vascularity of the synovial membrane, parts of the cartilage have undergone thinning, softening, or even entire removal, so that in some places the articular lamella of the bone is exposed, and in others the cartilage is loosened or detached.

In the more chronic forms of joint-disease, such as, for example, the scrofulous, the cartilage becomes inflamed and ulcerated in consequence of the encroachment upon it of granulation-tissue, either from the synovial membrane upon its surface, or from the bone beneath. From whichever surface the process may originate, the destruction of the cartilage is correspondent to the advance of the granulation-tissue. If from the synovial surface, the cartilage becomes thinned, pitted, roughened, and changed to a yellowish tint; the bones eventually becoming exposed, and undergoing a similar process of ulceration. If from the bone surface, the same changes occur on that side of the cartilage, large pieces of which may be detached as by a process of necrosis.

There is, moreover, another class of cases of joint-disease, in which the cartilages become early affected by the ulcerative process in consequence of the stimulus of a synovial inflammation, which, without having the extremely acute or irritative qualities of the septic form, is yet of a progressively destructive kind. In these cases the synovial membrane, though very vascular, is but slightly swollen or thickened, and the amount of fluid in the joint is usually but small, yet the cartilages are found to be extensively ulcerated, so that the articular lamella is exposed at a comparatively early stage of the disease. This form of joint-disease affects most commonly the hip-joint.

Microscopic examination of inflamed articular cartilage reveals the following changes:—There is, first, an increase in the size and number of the nuclei of the cartilage-cells, and absorption of the hyaline intercellular material; then, as the process goes on, the nuclei undergo granular degeneration, and those cells nearest the surface rupture and allow the escape of their nuclei; thus there ensues a loss of substance, and by the extension of the process the cartilage is gradually destroyed.

In the more chronic cases the cartilage may be seen to have undergone fibrillation rather than ulceration; or its destruction may be limited to the points at which the under- or overlying granulation-tissue has invaded it.

The *symptoms* of inflammation of articular cartilage are not in any way characteristic. The tissue is insensitive, and probably the spreading to it of inflammation from the synovial membrane or bone cannot be recognised until ulceration has occurred and the bone is exposed. When, however, this stage has been reached, the exposure and inflammation of the articular lamella gives rise to painful startings of the limb, which are greatly aggravated by any movement of the joint, and which become a prominent feature in the symptoms. This distressing muscular spasm is especially apt to occur just at the commencement of sleep, when, the voluntary control of the muscles being withdrawn, the sensitive bone-surfaces are drawn into acutely painful contact, and the patient awakes with a cry of pain. This is especially the case in disease of the hip-joint, and gives rise to the characteristic 'night-scream' of children thus affected.

The results of ulceration of the cartilage will vary much with the age and reparative power of the patient, the kind of disease with which it is associated, and the acuteness or chronicity of the process. If the disease is arrested before any considerable destruction of the cartilage has occurred, the surface may heal by the formation of fibrous tissue, which may merely fill up the gap, or may form an adhesion to a corresponding point upon the opposite surface of the joint. If the cartilage be extensively removed, either the joint will be destroyed by suppuration, or the destructive process coming to an end, there will be an effort at repair, and the opposed bone-surfaces will become firmly adherent by fibrous or osseous anchylosis.

In the *treatment* of ulceration of articular cartilage, rest and extension of the limb are primary essentials. Extension by a pendent weight, or suitable splints, will do much to prevent the painful muscular spasm described above; though occasionally this distressing symptom may necessitate tenotomy of the irritated muscles.

For the same purpose, also, the internal administration of opium, or the subcutaneous injection of morphia, is frequently necessary. The joint-disease (of which the ulceration of the cartilage is usually but a part) must, of course, be treated as a whole; but it may be added that in those cases in which the symptoms of ulceration of the articular cartilage are prominent or of early occurrence, counter-irritation, especially by the actual cautery, will usually be found to give great relief.

Besides the inflammatory affections above described, articular cartilage is liable to certain degenerative changes and disturbances of nutrition. A common condition in old people is a variable amount of fatty degeneration, in consequence of which the cartilage becomes thinned, roughened, and of a yellowish colour. In other instances fibroid changes occur, giving rise to a loss of smoothness and elasticity, generally with some atrophy. Such conditions, however, are not recognisable during life.

In gout a deposition of urate of soda takes place in the cartilage, interfering with its nutrition, and giving rise to wasting and calcareous degeneration.

Finally, in osteo-arthritis, the first changes are observed in the cartilage, which loses its proper smoothness, and becomes wasted and worn away at the points of greatest friction, while at the same time some irregular thickening occurs at its edges, where least subjected to pressure. *See* OSTEO-ARTHRITIS.

J. WARRINGTON HAWARD.

ARTIFICIAL ANUS.—The term artificial anus is applied to certain cases in which the lumen of the bowel communicates with the surface of the body through a breach in the intestinal wall. This communication may be met with under many different conditions, but to all such the present term is not applicable. In artificial anus the aperture in the gut is large, and opens directly upon the cutaneous surface of the body; the bowel is practically, if not in fact, connected with the integuments, and the escape of fæces is thus direct, and not through an intermediate fistulous passage. In other instances there is a communication between the lumen of the bowel and the cutaneous surface, but it is not direct. The gut in which the abnormal aperture exists lies at some distance from the surface, and between the bowel and the skin stretches a long fistulous passage, or a large abscess cavity intervenes, or the communication between the two parts is still more indirect. To these instances the term fæcal fistula, or stercopurulent fistula, is applied. In other cases again the bowel communicates with a mucous cavity such as the bladder or vagina, but to such examples the terms vesico-intestinal and vagino-intestinal fistula are applied. The term artificial anus, therefore, is used in but a limited sense; the limitation is arbitrary, and is based upon therapeutic grounds. The methods available for the treatment of artificial anus on the one hand, of vesico-intestinal and allied fistulæ on the other, and of fæcal fistulæ, so called, on the third part, are, as will be shown, very different.

Artificial anus may be divided into three varieties: 1. Congenital, 2. Accidental, and 3. Acquired.

1. To only one congenital condition may the present term be with propriety applied, to the condition, namely, where a Meckel's diverticulum opens at the umbilicus. This diverticulum, it may be remarked, is the remains of the vitelline duct, and in its most perfect condition it exists as a tube which extends between the navel and the ileum from one to three feet above the ileo-cæcal valve. This tube has a structure identical with that of the bowel from whence it springs. After the separation of the umbilical cord it is possible that it may open upon the surface and discharge fæcal matter. Such discharge is usually scanty and intermittent. It may persist for many years after birth. In most cases the opening, which is always small, will close spontaneously as the umbilical cicatrix contracts. Its closure may be aided by the application of the actual cautery, or, in instances where a somewhat larger aperture than usual exists, by a slight plastic operation.

2. In the accidental form of artificial anus the abnormal opening in the gut is brought about either by a wound, or by gangrene of the part, or by a perforating ulcer. If by a wound, then the damaged gut must have protruded at the orifice in the parietes at the time of the accident, must have become engaged in that wound, and ultimately have formed adhesions there. If, by means of a deep stab, a portion of the bowel—as, for example, the descending colon—is opened behind the peritoneum, so that that membrane is not damaged, the contents of the gut may be discharged upon the surface, but the condition would more usually lead to a fæcal fistula than to an artificial anus. In the same way gunshot wounds can only under rare circumstances lead to an artificial anus in the limited sense of that term, while they are frequently the cause of a fæcal fistula. Gangrene after strangulated hernia is a very common, and, indeed, the usual, cause of artificial anus. The gangrene may involve only a part of the convexity of the strangulated loop, or may implicate the whole of it, or the whole of the upper limb of the loop. Any form of ulcer of the intestine may lead to perforation. If the perforation takes place through a part of the bowel not covered by peritoneum, as at the posterior part of the descending colon, the intestinal contents find their way into the subserous tissue, an abscess is formed, and when that discharges itself through the skin, a fæcal fistula is formed, rather than an artificial anus. For this reason artificial anus can hardly result from ulceration having its seat in the colon, unless it be in the transverse colon. When such a form of abnormal opening has developed, as a result of intestinal ulcer, it will usually be found to have involved the small intestine. The ulcer, before it perforates, leads to some local peritonitis, by means of which the diseased loop becomes adherent to the parietes. By the time perforation occurs extravasation is prevented by the adjacent adhesions. An abscess follows, which in time breaks through the skin, and leads to an artificial anus.

3. In the acquired form the condition is the result of a colotomy or an enterotomy.

Anatomical condition.—There is, as a rule, only one opening in the skin, though in rare cases there may be more than one. The integument about the abnormal orifice is usually depressed, contracted, thickened, and excoriated. In cases of any standing it is continuous more or less directly with the mucous lining of the bowel. The gut—especially when it is a portion of small intestine—is much bent at the seat of the loss of substance. So great may be this bending that the segment of bowel below the anus may be parallel with that above it. As a result of this bending, a valvular fold appears on the wall of the bowel facing the aperture in the skin—on such part of the intestinal wall, indeed, as is left undestroyed. This fold is placed at the summit of the bend. Its extent depends upon the amount of intestine lost, and upon the acuteness of the angle formed in the bowel at the site of the artificial anus. It is more marked when the small intestine is involved than when the lesion is in the colon. It is perhaps most highly developed in cases that have resulted from gangrene. This valvelike fold or *éperon* is the chief cause of the permanency of the artificial anus, and the main obstacle in the way of spontaneous cure. It is often so extensive as to entirely cover over the opening in the bowel below the anus, and in any case acts as a conduit to direct the intestinal contents to the opening in the skin. The mesentery in the angle, which is always turned away from the surface, is found to be thickened, shrunken, and contracted, and takes a part in maintaining the permanency of the *éperon.* The bowel below the fistula is contracted, pale, and more or less empty, while the bowel above is often distended and not infrequently hypertrophied. The nature of the intestinal contents will obviously depend upon the part of intestine involved. The amount that escapes varies. All the fæces may be passed by the artificial anus in some cases, while in others there is but slight escape of fæcal matter, or only an occasional escape. The discharge from the fistula is influenced also by position, by the general health, and by the state of the bowels.

The skin about the abnormal opening may become the seat of much erythema or of erysipelas. The end of the bowel above the anus may become plugged or be occluded by acute bending, and symptoms of intestinal obstruction may follow. Much trouble — chiefly in the form of nausea, vomiting, and colic—may be occasioned by an accumulation of fæcal matter in the bowel below the artificial anus. The intestine may become prolapsed through the abnormal opening. This prolapse usually involves only the mucous membrane, but it may involve all the coats of the bowel. In the latter case it may be extensive and may even attain the length of one or two feet. As a rule the prolapse involves only one end of the bowel, and most frequently the upper end; it may, however, involve the lower end only. The prolapse may be reducible or irreducible. In certain cases a hernia has appeared at the seat of an artificial anus, the protrusion having been covered either by the thinned tissues about the anus, or by the wall of the bowel that is involved therein.

The *Prognosis* is unfavourable. When the anus involves the jejunum the patient, as a rule, soon dies of marasmus. When the middle ileum is implicated there is usually much wasting and malnutrition. When the lower ileum or colon is involved, the health need not become impaired by reason of the premature escape of the contents of the bowel. The condition usually involves much mental distress. In certain cases—more especially when the lesion has been due to hernia—spontaneous cure has followed at the end of weeks or months. Spontaneous cure, however, in the condition to which the special term artificial anus is applied, is quite rare.

Treatment.—The skin about the artificial anus must be protected as much as possible. It may be painted with collodion, but the collodion only obtains a very temporary hold of the integument. It may be kept constantly oiled with vaseline or with simple ointment. Attempts may be made by means of thin india-rubber tissue to conduct the escaping fæces away from the skin into a proper receptacle. The general health should be supported. If the fistula lie in the colon, the motions should be kept soft and constipation be carefully guarded against. Inordinate intestinal movements should be checked by opium. The diet must be cautiously selected, and be composed only of the most digestible materials. A suitable pad must be worn to receive the escaping fæces. Some are made for the purpose by instrument-makers, but as a rule the patient will construct some pad of his own which will suit the purpose better than a more elaborate receptacle. In any instance the most scrupulous cleanliness must be insisted upon. In slight cases spontaneous cure may be brought about by closing the abnormal aperture by pressure. This pressure may be effected by means of a truss or by a disc fixed over the fistula ; or the edges of the anus may be approximated by strapping. In a recent case Mr. Banks effected a cure by inserting a piece of india-rubber tube into the two ends of the bowel. This brought elastic pressure to bear upon the *éperon*, while, at the same time, it maintained the passage of the intestine free.

The great obstacle to cure is the *éperon.* This has been kept thrust back by means of ivory plugs carefully fixed in the part, and attempts have been made to destroy it by the frequent application of caustics or the occasional use of the actual cautery. It must be confessed, however, that these various measures are of little avail. They possibly do no harm, but they certainly do little good. In any case of persistent artificial anus it is better to adopt a careful palliative treatment, to allow a reasonable time to elapse for the development of any evidences of spontaneous cure, and then to treat the condition by some radical means if it still remains without improvement.

These latter measures may be considered under three heads: 1. Denonvilliers' operation; 2. Dupuytren's operation; and, 3. Resection of intestine.

1. The operation of Denonvilliers is merely one of the many that have been proposed for the cure of this condition by what may be termed plastic measures. In the present procedure the mucous membrane is dissected up on either side of the artificial anus, its edges are freshened and then united by sutures. The integument is next dissected up, its edges are in like manner freshened and are approximated by sutures. This operation is of little value. It is well known that mucous surfaces are not readily induced to unite, and the barrier offered after the operation to the pressure within the bowel is very slender. The procedure, moreover, leaves the *éperon* untouched, and thus fails to attack what is probably the real cause of the persistence of the fistula.

2. In Dupuytren's operation the *éperon* is destroyed by inducing gangrene in it. This is effected by means of Dupuytren's enterotome. The enterotome is a strong pair of forceps with a male and female blade which can be freely and closely approximated by means of a screw. The *éperon* is taken up between the two blades, which are at once screwed together as tightly as possible. In from eight to ten days the *éperon* will have become ready to be separated, and the instrument may then either come away of itself, or—if it still holds on—may be removed. A free communication is thus established between the bowel above and below the abnormal opening, and a spontaneous cure commonly follows, the parts being left practically to themselves. In the reported cases such cure has followed the operation at a period varying from a few weeks to three or four months after the removal of the enterotome.

3. In this procedure the two ends of the intestine concerned in the artificial anus are resected, and the cut ends at once approximated by sutures by the first of the two methods described in the account of resection of the intestine. *See* Colectomy; Enterectomy. The edges of the openings in the integument are freshened and the parietal wound is closed after the sutured bowel has been reduced into the abdominal cavity. By this method the artificial anus can be readily and surely treated, and the success of the operation in the fistulous conditions which have followed strangulated hernia has been very encouraging. It is certainly a great advance upon the uncertain, tedious, and somewhat dangerous procedure of Dupuytren. The resection operation is by no means free from danger, but its risks are, in the writer's opinion, capable of being estimated and to a great extent guarded against. Frederick Treves.

ARTIFICIAL LIMBS, The Selection of.—The Lower Extremity.—The chief types of artificial limbs for this, are (1) the common pin or kneeling leg, (2) the bucket leg, (3) the bucket leg with a knee-joint, (4) the artificial leg proper, commonly described as the 'cork leg,' by those who are not aware that cork is no longer used in its construction.

The common pin or *kneeling leg* is made of wood (usually beech or ash for men, and willow for women). The socket is shaped like the letter U. The stem is a simple upright pin, pole, or stick, in fact the ordinary 'wooden leg.' A broad leather girdle surrounds the socket up to the middle of the thigh, a waist-band fixes the upper extremity of the outer branch of the U to the pelvis. This outer branch extends upwards much higher than the inner. The lower end of the pin is shod with leather, and sometimes provided with a spring. The weight of the body bears directly upon the bent knee as it lies in the fork of the U.

The bucket leg is a somewhat superior article to the pin leg. Its socket is bucket-shaped, and resembles an immense thimble inverted, and is made of willow wood and leather. The stem resembles that of the pin leg. When used for amputation of the thigh it is frequently made with a joint at the level of the knee, an obvious improvement.

The artificial leg proper. This is almost entirely made of willow; and the writer is told that the best wood grows on the banks of the Kennet, and is not easy to obtain. A certain amount of leather is used, especially in the upper parts. The joints are of wood, and the fastenings are of German silver with screws of plated steel. When used for a thigh amputation, an artificial limb contains joint mechanism for both the knee and the ankle. Sometimes this consists wholly of rubber bands; but the best makers usually dispense with these, and employ instead a strong spiral steel spring and a 'tendon' of the strongest catgut covered with leather. The spring passes down, inside the calf, from the knee to the heel, and when the knee is slightly bent pushes the heel down, at the same time lifting the toes. This is exactly what takes place when the artificial foot is carried forward in walking. On the other hand, the catgut 'tendon' (which lies side by side with the steel spring in the calf, but has a different attachment at the knee), comes into play when the knee is extended. It then drags on the heel, and holds the foot firmly down, so as to make it possible to stand on tiptoe by inclining the body forward a little. Thus the catgut tendon assists in the push off, and the steel spring tilts the foot up free of the ground, in the movement of walking. The mechanism just described is that of the well-known 'Anglesea leg.'

When the wearer sits down and bends the leg to a right angle, the steel spring is temporarily released from pressure at its upper end, and does not return into play until the knee is extended again about thirty or forty degrees. Braces of buckskin are used for both men and women, the former wearing them simply over the shoulders, the latter wearing also a waistbelt, to which the shoulder braces are attached in such a way as to leave the breasts free from pressure.

For a case of amputation below the knee with a long and good stump, it is sometimes unnecessary to take any bearings from the thigh. Artificial limbs, to take bearings from a bent knee (after the manner of the kneeling or pin-leg,) are sometimes made with a mere 'stop' knee-joint, and sometimes with a 'spring and tendon action knee-joint,' analogous to that described above.

For amputation below the knee in cases *where the bearings have to be taken from the thigh* as well as from the leg, artificial limbs cost as much as do those for thigh amputations. Artificial limbs for very high amputations of the thigh cost a few pounds extra according to the difficulties of the case.

Artificial limbs for *exarticulations at the hip*, whether done subperiosteally or otherwise, are for the most part useless, and are therefore dear at any price. The writer thinks, however, better results might be got by taking a firmer and more complete hold of the pelvis than is usually attempted, and is at present making some experiments in the matter.

For *Syme's*, *Pirogoff's*, *Chopart's*, and *Tripier's* amputations, the lost parts are replaced by new ones of light wood. As the bearings are directly on the stump itself, or on the heel in the last two cases, the artificial foot has merely to be fixed in position. This is usually done with a pair of steel rods, one on each side the leg, and a leather case, laced round the calf.

The kneeling or pin leg is not only excellent for permanent wear, when the amputation is in the upper third of the leg, but is often worn temporarily while the stump of a lower amputation, e.g. a Syme, is still tender and unfit to bear pressure.

When a Chopart is done in childhood, the limb does not grow as fast as its fellow. Consequently the instrument-maker must either fit on a high boot, or else apply a foot entirely artificial, attempting to conceal (not generally with much success) the knobby stump which now constitutes a kind of false and unsightly ankle. From an instrument-maker's point of view, Chopart's amputation should never be performed in childhood.

Lost toes; Hey's amputation, &c.—The patient gets his boot-maker to pad the shoes in a suitable manner.

The stump-boot.—This is a cylinder of leather which grasps the calf, and is shod with leather like a boot. It is a cheap instrument for a case of Syme's amputation. It has no foot, but merely a circular sole of the same radius as the cylinder itself.

THE UPPER EXTREMITY.—Here again the materials are willow-wood and leather. But the hand and fingers are made of the wood of the lime tree. Proportionately, much more leather and less wood are used than in the case of the lower extremity.

Elbows are merely fitted with hinge-joints, unless a part of the forearm is left, when any power of pronation or supination should be carefully utilised. The elbow should be supplied with a little catch capable of fixing it at any angle.

The hand is fixed into the wrist by a metal socket and catch, and can easily be removed. The thumb contains a steel spring which opposes it to the fingers. The finger-joints are as a rule free from springs, but are purposely made to work passively with stiffness. But both thumb and fingers can be fitted with a grasping mechanism worked by either (1) the extension and flexion of the elbow, or (2) the pronation and supination of the forearm.

Sets of instruments are supplied (spoon, fork, knife, brush, hook, &c.), which screw into the palm of the hand, but have the appearance of being held by the thumb and fingers. But if a simple hook, with one or two instruments, such as a fork and spoon, be supplied instead of the hand, we get what is called a *bucket arm and hook*, much cheaper than 'an artificial arm,' by which is understood one with a hand. Not only table instruments, but trade instruments and tools, are made to screw into both artificial hands and bucket arms.

Artificial thumb and fingers.—When parts of the hand are lost, it is sometimes for the sake of appearance rather than for any other object that the mechanician should be applied to, except when a thumb is left without a finger to oppose to it, or *vice versâ*, or when both thumb and fingers are gone. In the former case especially excellent practical results can be obtained.

The cost of these appliances varies with the case, but is not usually much less than that of a new hand and forearm.

It has been already mentioned how useless all appliances are for most cases of amputation at the hip-joint. Artificial arms for amputation at the shoulder-joint are useful in an æsthetic rather than in a practical sense.

General remarks.—The various appliances in ordinary use in this country have thus been briefly described. Their merits have been tested by experience, and are not small. But an artificial limb of any kind, standing side by side as it usually does with its fellow, constructed by nature, does not, and never will, bear the comparison. Hence there are constant efforts to produce new forms of artificial limbs. It would be out of place to discuss here all these. Mention may be made of the artificial leg of Dr. Hermann, which will firmly support the weight of the body at whatever angle the knee may be bent, and the artificial limbs termed 'the Beaufort,' which occupy a position, as regards both appearance and price, midway between the complete artificial limbs described in this article and the mere bucket and pin legs.

General remarks on the choice of an appliance.—As a rule the simpler the appliance the more useful it is. This applies especially to the lower extremity. The direct contrary is generally believed by the ignorant. For example, a labourer wearing a bucket leg after a high thigh-amputation, does not get on very well. He longs for an expensive artificial limb with a knee-joint and foot. Nothing but experience will convince him that the latter will be even less useful. On the other hand a gentleman with a first-class artificial leg is often guided by common sense into getting for himself a simple 'bucket leg with knee-joint' to use for rough and active work.

It is extravagant and silly to supply growing children with elaborate artificial legs and feet. They require bucket legs, stump-boots, and the like, which can be frequently readjusted to their height, and are strong enough to stand playground usage.

Congenitally short arms and legs, if very short indeed, should be treated as mere stumps and fitted with artificial limbs. A clever instrument-maker will utilise every peculiarity of such a limb to increase its hold of and firm bearing on the appliance. Of course, if an arm has anything approaching to a useful hand attached to it, it is scarcely right to bury it in an artificial limb.

Measurements. — Space will not give room for elaborate details. Where possible, it is best to let the instrument-maker take his own measurements, or, when that cannot be done, to write to him for a paper of printed forms, diagrams, and directions. In remote regions attention to the following rules may suffice :—

(1). State whether a right or left limb is required.

(2). Give full measurements of the sound limb.

(3). State the exact spot where the amputation has been done (in inches.)

(4). Give a complete series of measurements of the stump.

(5). If the growth of one limb has not kept pace with that of the other side, indicate the exact position of each joint by measurements.

(6). Give tracings of the stump of the sound hand (or foot, as the case may be).

Casts are useful in the case of Chopart's amputation, or when a hand or fingers or thumb may be required. A tracing does for a Syme. A boot is useful.

The measurements of a sound leg should be taken with the knee extended. Of girths, there should be sent, one of the waist, two of the thigh, one of the knee, one between the knee and calf, one round the calf, one round the ankle, one between the last two. Send the exact height in inches of each girth measured. Send a shoe-maker's measurement of the foot, or else a shoe.

Of perpendicular heights, do not omit to send (1) the height from the fork to the ground ; (2) the height from the summit of the bent knee to the ground, and (3) from the middle of the calf to the ground.

Similar principles can be applied by any intelligent person to the upper extremity ; but it should be measured with the elbow bent.

C. B. Keetley.

ARTIFICIAL PUPIL. *See* Iris, Diseases of the ; Iridectomy.

ARTIFICIAL RESPIRATION. *See* Suspended Animation.

ASPHYXIA. *See* Suspended Animation.

ASPIRATION.—Before attempting to aspirate, it is necessary to thoroughly disinfect the needle, or trocar and canula, by means of the flame of a spirit lamp, or by some strong antiseptic agent. In using Dieulafoy's aspirator, the whole interior of the apparatus must be cleansed by allowing a quantity of strong carbolic solution (1 in 20) to pass through the tubes. Any defect in the taps or working of the syringe will then be detected. Great care must be taken, in using the finer needles, to push on in one direction only; and when using the aspirator for exploratory purposes, to establish the vacuum in the needle so soon as it has penetrated the skin and superficial structures. If, on pushing the needle as far as is thought judicious, no fluid be obtained, the needle must be withdrawn, and a fresh exploratory puncture made in another direction. The selection of the size of the needle or trocar to be used depends on the situation of the fluid and on its suspected character.

An advantage claimed for Dieulafoy's aspirator is that if the needle become choked it may be cleared by pushing down the piston, and driving some of the fluid back; but in using Potain's aspirator, the canula may be cleared, when necessary, by the careful introduction of a pilot trocar.

In acute abscess, aspiration rarely effects a cure, and is not advisable, but has been successfully employed in some acute cases of pelvic and abdominal suppuration. In some rapidly-forming pus collections, such as certain pyæmic abscesses, and in empyema in young children, aspiration may sometimes be employed with success.

Chronic abscess, unconnected with bone-disease, may occasionally be cured by one or more aspirations.

Large chronic abscesses in connection with disease of the spine, and of the hip, have been successfully treated by repeated aspirations. The indication for continued perseverance in this treatment is the increasing length of the interval between the successive accumulations in the cavity. In these bone abscesses, and especially in spinal abscess, unfortunately the pus generally rapidly re-collects after aspiration; and very often, owing to the amount of cheesy material in it, there is great difficulty in its evacuation. The largest trocar should be used, with antiseptic precautions, and care is necessary, in withdrawing the canula, not to leave any pus in its track, or a sinus is likely to be established. Aspiration must of course in all cases cease at once if blood should flow in any quantity.

Effusion into the pleural cavity is best evacuated by the aspirator. The operation is a little longer than tapping with special trocar and syphon tube, but there is less chance of the admission of air, and greater certainty of obtaining the fluid when negative tension exists. If the fluid be found to be purulent, it is generally best in adults to provide free drainage at once; but not infrequently in children, after one or two aspirations, there is no further secretion.

Pericardial effusion may be withdrawn safely by using a fine needle. The puncture should be made in the fourth or fifth interspace, about two inches from the left side of the sternum, and the needle must be passed upwards and inwards. To avoid penetrating the heart, it is important to obtain the vacuum in the needle so soon as the point is beneath the skin, and the needle should be held steadily during the flow of the fluid. *See* Paracentesis.

Hydatid cysts in the liver and other organs, when they contain clear fluid, will often shrivel up after aspiration; but relapse sometimes occurs after an apparent cure. A suppurating hydatid cyst, or an abscess of liver, may be explored by means of an aspirator, and their situation and depth from the surface determined; but for the treatment free drainage is necessary.

When there is a large collection of free fluid in the peritoneal cavity, a small syphon trocar is generally employed for its evacuation; but the aspirator is by far the safer instrument when the fluid is localised, or there is a doubt as to the diagnosis. For the exploration of any deep-seated collection of fluid in the abdominal cavity, only the finer needles should be used, and great care is necessary that intestine does not lie in front of the swelling at the seat of puncture.

A hydronephrosis may be aspirated at a point just below and anterior to the last rib; but the situation of puncture will vary according to the particular case.

Retention of urine may be relieved by the aspirator.

In aspirating joints, the interior of the joint must not be scratched with the needle or canula, and the limb must be kept at rest after the operation. The knee-joint not unfrequently requires aspiration for chronic effusion, or for distension with blood as a preliminary to the treatment of a fractured patella; and for the withdrawal of pus in certain pyæmic effusions, where the distension of the joint is sudden and unattended with signs of destructive changes. The aspirator or hypodermic syringe may also be employed for the purpose of diagnosis in doubtful effusions into a joint.

The aspirator has been recommended for the relief of gaseous distension of the bowel, and as a method of treatment in certain cases of strangulated hernia. It is, however, preferable to use a very fine trocar and canula, and to allow the air to escape without assistance by aspiration, which only tends to increase the chances of fæcal extravasation. The treatment of hernia by fine puncture has found little favour with English surgeons, and can only be very rarely advisable. Bernard Pitts.

ASPIRATOR.—This instrument was introduced into practice by Dieulafoy, in 1869, and with slight modifications the simplest form now in use is that designed by the inventor. It consists of a glass syringe, in which the nozzle has been replaced by a threeway tap. This tap places the cylinder of the aspirator in communication with two tubes, one connected with a hollow needle, and the other for carrying aspirated fluid away from the cylinder. It is so designed that the passage to either or both can be closed; in the latter case when the piston is withdrawn a vacuum is formed in the cylinder. If now the communication with the hollow needle is opened, the fluid in any cavity into which the needle has been inserted flows into the cylinder, and by turning the tap the communication with the needle is closed, and on depressing the piston the fluid obtained can be ejected, and the process repeated. The tubes are made of india-rubber, with coils of wire inside to prevent them from collapsing. The needles vary from $\frac{1}{50}$ to $\frac{1}{12}$ of an inch in diameter.

The advantage of using a hollow needle is that a vacuum can be produced in it as soon as the skin is penetrated, and it is then hardly possible to pass it without result through a collection of fluid.

Potain's Aspirator is a very useful one for ordinary practice. The apparatus consists of two parts—an exhausting syringe, and a glass bottle in which the vacuum can be produced. The apparatus is so fitted that any ordinary bottle with a narrow neck, and which will hold from two to three pints, can be employed. In the neck of the bottle is fitted a rubber plug, through which passes a metal tube with two branches, each of which is closed by a tap, while their extremities are fitted for receiving the conical metal ends of the india-rubber tubes which lead to the exhausting syringe and the hollow needle respectively. In place of the needle a trocar and canula can be used; but it is essential that the tube leading to the exhaust bottle should be attached at an angle to the canula, so as to permit of the trocar being withdrawn beyond the point of attachment of the tube without the possibility of admitting air into the canula.

In the aspirator just described, as the fluid does not come in contact with the syringe, the instrument is easily cleaned, and is not so likely to get out of working order as Dieulafoy's aspirator. With care in turning the taps, the bottle when full can be emptied, and again put in use, and large quantities of fluid be drawn off with little trouble or manipulation, the needle or canula remaining *in situ* during the process.

For exploratory purposes a small aspirator made on the same principle as Dieulafoy's may be employed, but a large-sized hypodermic syringe, with a long fine needle, is an excellent practical substitute. One loses, however, the advantage of the previous vacuum in the needle, and, consequently, fluid situated at an uncertain depth in a solid organ like the liver might be overlooked. Bernard Pitts.

ASTHENOPIA.—The term asthenopia signifies *weakness* of sight, as opposed to *dulness* of sight, or amblyopia, and is characterised by the patient having good vision so long as distant objects alone are regarded, and for a short time even when near objects are looked at, but in the latter case soon becoming fatigued and exhausted. It is usually regarded as presenting three forms, or perhaps, more correctly speaking, as attributable to three causes—weakness of the ciliary muscle, weakness of the internal recti-muscles and weakness of the retina. These are named respectively accommodative asthenopia, muscular asthenopia, and nervous asthenopia.

1. *Accommodative asthenopia.* This form is associated with hypermetropia (q. v.) In the hypermetropic eye the focus for parallel rays lies behind the retina, so that an effort of accommodation is required even to see distant objects distinctly; still greater of course must the effort be to see near objects from which proceed divergent rays. In moderate degrees of hypermetropia, and in young persons in whom the nervous power is considerable, the ciliary muscle active and the suspensory ligament and lens resilient, the effort can be maintained for a considerable period, even when minute objects are closely examined; but sooner or later the muscle becomes exhausted, and

then, if work is still persevered in, the muscle either passes into a state of cramp, known as spasm of the accommodation, or—which is far more common—the symptoms of accommodative asthenopia are experienced. These symptoms are that, after reading, writing, or paying attention to any near object for some time, a sensation of fatigue is experienced in the eyes. The letters of a word, or the lines on a page, or the stitches in work, become confused and run together, and though at first, by making a stronger effort, reading can still be continued, in the course of time, varying, with the degree of hypermetropia from a few minutes to an hour or more, everything becomes confused, and even moderately large print is illegible. Then the eyes become hot and feel full. The lids are swollen and congested. The secretion of the Meibomian glands being disordered, the edges of the lids become sore, and ciliary blepharitis is sometimes established. The conjunctiva is reddened. There is an increased flow of tears. The patient feels inclined to squeeze the lids together and to rub the eyes strongly with the fingers. He has often to rest them by looking away from the book or work, and finds relief in bathing them with cold water. Improvement is felt when books are put aside and open air exercise taken. In some the eyes are worst at night, especially if the type and the light are alike bad; but in others the vision is most dim in the morning, perhaps for the same reason that after a long and severe walk the muscular pain is greatest in the morning and wears off after gentle exercise. Muscæ and spots are often complained of. These are sometimes visible, and are doubtless particles of pigment detached from the ciliary processes or uvea by the rubbing and pressure of the eyes. Failure of the power of accommodation often makes itself felt during convalescence from some disease, when, owing to general weakness of the nervous system, the effort previously made without difficulty to overcome preexisting hypermetropia can no longer be made. The treatment of accommodative asthenopia must consist either in giving up all near work and leading an out-of-door life, or in the use of appropriate correcting glasses. The rules by which the selection of these should be undertaken are given in the article on hypermetropia. *See* REFRACTION, Errors of; HYPERMETROPIA.

2. *Muscular asthenopia* is due to defective power or 'insufficiency' of the internal or external recti-muscles. On looking at a distant object the visual axes in a healthy person are parallel, but when near objects are regarded, not only is there an effort of accommodation, which is effected by the ciliary muscle, but the internal recti contract, and the visual axes are made to converge. If either of the internal recti are weak, an unusually strong nervous impulse has to be generated by the nerve-centre to maintain the contraction of the muscle, and fatigue, soon amounting to pain, is experienced. After a little while the effort can no longer be sustained, and then the eye rolls outwards, under the influence of the opposite rectus, and diplopia results. In some cases the effort is so trying that severe headache and even vomiting may be induced when close work is compulsory, whilst in others chronic conjunctivitis may be established, with frequent attacks of phlyctenular ophthalmia. The insufficiency of the rectus internus can easily be ascertained by a simple experiment. A thick black line three or four inches long should be ruled vertically in the middle of a sheet of paper, and in the centre of the line a spot or short cross-bar made. A prism of 10° or 12° should now be held with the base downwards before one eye. If the recti are in a normal condition, and the sheet be held at a distance of about six feet, two images of the spot will be seen, one exactly above the other, but only one of the line through this will appear prolonged. If, however, there is insufficiency of one muscle two lines as well as two spots will be seen, and the image seen by the eye before which the prism is placed will be higher than the other, and crossed or shifted to the opposite side. The reason of its occupying this position is, that the prism throws the image upon a lower part of the retina, and, in accordance with the law of projection, it appears to be higher, whilst the weak internal rectus muscle being no longer compelled to contract in order to effect the fusion of the two images, gradually yields to the external rectus, and the eye rolls or deviates outwards and, again in accordance with the law of projection, gives a crossed double image, so that if the right internal rectus is insufficient, the image is on the left side, and *vice versâ*.

The degree of insufficiency may be approximately ascertained by a simple proceeding, for by still keeping the prism with its base downwards before the eye, it is only necessary to place a succession of prisms with their bases inwards before this eye until one be found which causes the two images to be superimposed—that is, to give two spots but only one line—and the amount of insufficiency is at once determined. Unfortunately, in many instances the position of rest or equilibrium is not immediately assumed by the eye at fault, a strong nervous impulse being still directed to the muscle even when the images are separated by the first prism, and hence the amount of latent divergence is often considerably under-estimated. The treatment of muscular asthenopia must consist in the employment of appropriate prismatic glasses, superadded to those that are requisite to correct any other error of refraction, such as myopia, astigmatism, &c., with which insufficiency of the internal rectus is often associated. *See* Strabismus; Ocular Muscles, Affections of the.

3. *Nervous Asthenopia.*—This form of asthenopia appears to be associated with general depression of the nervous system, and is then due to the circumstance that the patient, whilst possessing perfectly normal vision, cannot, without great distress, bring the ciliary muscle into action. As soon as a book is taken up or sewing commenced, the mere effort of accommodation, which in health can be easily and long sustained, occasions an insupportable feeling of fatigue, and it is quickly put aside. Such a condition may not infrequently be seen in women recovering from their confinement, in children suffering from spinal disease or convalescent from measles, scarlet fever, or diphtheria, in those who have suffered from hæmorrhage; and the writer has repeatedly observed it in riveters and fitters in Chatham Dockyard after contusions of the eye, to which they are particularly exposed. It may also be noticed as a symptom in the early stage of sympathetic ophthalmia. In these, as well as in the former class of cases, the powers of the retina appear to fail, a dark spot or scotoma quavers before the eye, confusing, or altogether obliterating, the outline of any object that is attentively regarded, and a contraction of the field of vision may sometimes be noticed. The retina seems, in some instances, to be hyperæsthetic, so that bright lights, especially when they flicker or vary in intensity, annoy and distress the patient. The most careful examination of the eye by means of the ophthalmoscope often fails to discover any abnormal condition (*see* Accommodation, Disorders of). The treatment should be both local and general, the local treatment consisting in directing the patient to desist from all work requiring close attention, and, where intolerance of light is a prominent symptom, the protection of the eyes with smoked, blue, or green glasses. The general treatment must, of course, depend on the conditions of the system to which the asthenopia may be referable. The best remedies are strychnia—which may either be injected in doses of one-twenty-fifth up to one-tenth of a grain every day, or may be taken in the form of tincture of nux vomica, in doses of ten to twenty minims—and such tonics as quinine, iron, arsenic, and sulphate of zinc. As a rule, such cases ultimately, though often but slowly, recover.

Henry Power.

ASTIGMATISM.—A condition of the eye in which entering rays are unequally refracted in different meridians, such rays being consequently never focussed to a point, as in the ordinary eye. *See* Refraction, Errors of.

ASTRAGALUS, Dislocations of the.—The astragalus may (1), whilst retaining its relations to the tarsal bones, be dislocated from the tibia and fibula. These tibio-tarsal dislocations are described as dislocations of the Ankle-Joint. (2) Whilst preserving its relations to the tibia and fibula, it may be dislocated from the bones of the foot; these dislocations are described as Sub-Astragaloid. (3) It may be separated from its normal attachments both to the tibia and fibula and to the bones of the tarsus, and be displaced alone. These proper dislocations of the astragalus will be here described.

The proper dislocations, or enucleations, of the astragalus are usually described as four in number, viz.: *forwards*, *backwards*, *inwards*, and *outwards*. But the forward dislocation includes displacement in three directions, viz. *forwards and upwards*, so that the head rests above the scaphoid and cuneiform bones; *forwards, upwards, and outwards*, when the head rests on the cuboid; and *forwards, upwards, and inwards*, when the head rests above and internal to the scaphoid. So also the backward dislocation includes dislocations *directly backwards*, and dislocations *backwards and outwards*, and *backwards and inwards*. Besides the direction of its displacement, the dislocated bone may be found rotated on a vertical or on an antero-posterior axis. For these rotations, Barwell suggests respectively the terms 'version' and 'torsion.' It has even happened that the bone has been turned completely over, so that the under surface looked upwards.

The forward dislocations are caused by over-extension of the foot. The ligaments attached to the astragalus are thus torn through, and the tibia, gliding down on its posterior surface, forces the bone out of its bed. Rognette, experimenting on the dead subject, found that he was only able to produce a forward dislocation, and he therefore concluded that the others were produced secondarily.

Symptoms.—The sign by which the injury may be recognised is the presence of an abnormal bony prominence projecting boldly beneath the skin in front of the ankle. The rounded head of the astragalus will be recognised at the anterior part of the prominence, and behind this will be felt the trochlear surface. The presence of the latter is of importance, and sufficient to distinguish this injury from subastragaloid dislocation of the foot, which has often been confused with it. When complete, the height of the foot is diminished, owing to the tibia settling down upon the os calcis, and the malleoli are brought nearer to the ground. At the same time the motions of the ankle are lost. When the bone is inclined outwards the foot is somewhat inverted, and when inwards the foot is everted.

To reduce this dislocation the patient's leg should be flexed to a right angle with his thigh, to relax the gastrocnemius; one assistant should then fix the knee, whilst a second, seizing the heel with one hand and the instep with the other, makes extension on the foot. The surgeon then, by pressing on the astragalus with his thumbs, may succeed in replacing it. Should extension and manipulation fail to reduce the bone, the tendo Achillis should be divided, by which means the soleus is paralysed. Any other tense tendons—the peronei, anterior tendons, or tibial—may also be divided, to aid in reduction.

All attempts to reduce the bone having failed, the foot may be secured on a splint and left covered by an icebag till the swelling has subsided. A fairly useful limb may in this way be obtained. More commonly, however, the skin sloughs over the bone and necessitates secondary excision. The statistics at present are in favour of secondary rather than primary excision, but if the case were treated from the first antiseptically, it is probable that these statistics would be modified or reversed. The writer would throw it out as a suggestion that, under these favouring circumstances, a free exploration might be made and all opposing bands divided till the astragalus could be replaced. There is no good reason for supposing that, because it was temporarily detached from its connections, it must therefore of necessity become necrosed, and the experience of simple complete dislocations favours the view that it would recover.

Dislocation backwards is caused by over-flexion of the foot on the leg. The ligaments are in this way torn, and the tibia, descending upon the neck of the astragalus, forces the bone into the space beneath the tendo Achillis. The bone may be found lying directly beneath the Achilles tendon, or it may be deflected to one or the other side; hence we have dislocations directly backwards, backwards and outwards, and backwards and inwards. If forced directly backwards without rotation or version the tendo Achillis may be pressed upon, as happened in a case described by Phillips, where this tendon was made 'to describe an angle of 40 degrees.' At the same time that the projection behind is noticed, a deep hollow can be felt with the finger immediately in front of the ankle, whence the bone has been displaced. Another symptom that has been noticed is extreme flexion of the great toe, which is readily accounted for when the position of the groove for the flexor longus pollicis on the back of the astragalus is remembered. The malleoli descend, and the foot has sometimes presented an appearance of slight shortening, but it is neither inverted nor everted. It should be remembered that, owing to the hollow in front of the tendo Achillis being liable to be filled up with blood-effusions after injuries to the ankle, the backward dislocation may be overlooked, and this occurred in a case related by Boyer, and in another described by Fergusson.

To reduce this dislocation, the leg should be first flexed on the thigh, then, extension being made on the instep and heel and counter-extension at the knee, the surgeon should endeavour to press the bone forwards into its place. At first the foot should be strongly flexed, and when the bone has been engaged in the gap between the tibia and os calcis, the foot should be gradually brought down to a right angle, at the same time that forward pressure is still exerted on the astragalus. Of eight recorded cases only one was reduced, and in this case both malleoli were fractured, but the patients have recovered with useful feet. Owing to the space into which the dislocation takes place, there is less stretching of skin and less necessity for excision in this than in other dislocations of the bone. If compound, it is probably the best practice to excise immediately attempts at reduction have failed.

The lateral dislocations of the astragalus are almost invariably compound, and usually associated with fracture of one or both malleoli.

In *dislocation inwards* the bone escapes below the tendon of the tibialis posticus. The bone is seen protruding beneath the inner malleolus, and is often rotated on an antero-posterior axis. This torsion of the astragalus, so frequently noticed, appears to be caused by the pressure of the opposite malleolus, whilst the tendon of the flexor longus pollicis behind probably determines the axis of rotation. As might be expected in this dislocation, the posterior tibial artery is sometimes ruptured and the accompanying nerve lacerated.

In *dislocation outwards*, the bone protrudes immediately beneath the outer malleolus, and above the tendons of the peroneus longus and brevis. The outer and inner malleoli are almost always fractured, but in a few instances they have both escaped. The foot is bent inwards, and the bone protrudes between the malleolus and os calcis.

In the treatment of the compound dislocations of the astragalus, inasmuch as the violence producing them is great, the question of amputation will have first to be decided. This will be determined by the amount of damage to the soft parts, the injury to vessels, exposure of tendons, and comminution of bones. Having decided against amputation, the surgeon will probably attempt, by extension and manipulation, to reduce the bone. Should he fail in this, there still remain two courses open to him. He may saw off the projecting head, and then again endeavour to effect reduction, or he may proceed at once to excise the whole bone. Even rupture of the posterior tibial artery and laceration of its accompanying nerve (though injuries adding much to the responsibility of an attempt to save the foot) should not alone frame the surgeon's resolution in favour of amputation, for in a case of this kind related by Astley Cooper, the bone was excised and recovery took place.

R. CLEMENT LUCAS.

ATHEROMA. *See* ARTERIES, Diseases of.

ATLANTO-AXIAL DISEASE. *See* CARIES OF THE SPINE.

ATLAS, Fracture and Dislocation of the. *See* BACK AND SPINE, Injuries of the.

ATRESIA ANI (Imperforate Anus). A congenital condition from arrest of development at an early period of intra-uterine life, resulting in an absence of the normal communication between the surface of the body and the interior of the lower end of the alimentary canal. This canal is, at the fourth week of intra-uterine life, a tube, closed at both extremities, and opening anteriorly at its lower part into the sac of the allantois, of which the intra-abdominal part subsequently becomes by development the bladder and urachus. About this time a depression is formed on the surface of the embryo at the site of the future anus, and by the upward extension of this the anal channel is developed, the upper end of which is in close proximity to the lower end of the bowel. By absorption of the intervening tissues the normal opening is established. At the same time a separation is being formed between the rectum and the bladder. This is usually completed by the tenth week of fœtal life. During the next few weeks, the growth of the perineum separates the urethra in the male, and the genital tract in the female, from the rectum. But this process of development may be arrested in any stage and in varying degrees.

Sometimes at birth the anus is almost or altogether absent. This constitutes atresia ani. In other cases the anus is well-formed, but is separated from the bowel by a thin membranous septum, constituting atresia recti. In other cases the rectum may have been badly developed, so that the bowel may cease at the level of the promontory of the sacrum or even higher. Again, imperforation of the bowel may be complicated by the persistence of a communication between the rectum and the bladder or urethra in the male, or the genital tract in the female; or, more rarely, there may be abnormal fistulous openings on the back and abdomen. Another rare form of atresia ani results, not from mal-development, but from adhesion of the epithelial surface of the anal passage. The diagnosis of these cases cannot cause any difficulty. If the anus be absent the defect must be at once apparent. But if there be an anus, and an obstruction higher up, the absence of any alvine discharge and the vomiting which will speedily supervene, together with distension of the abdominal parietes, will indicate the nature of the case, of which assurance can be obtained by the introduction of a blunt probe into the anal passage. The discharge of meconium by the urethra, vagina, or fistulæ elsewhere, will demonstrate the additional complications.

Treatment.—If atresia ani be due merely to epithelial adhesions, traction from the median line on both sides of the perineum will suffice to separate them, and re-adhesion may be prevented by the occasional introduction for a few days of a pledget of oiled lint. If there be a membranous septum between the anus and the rectum this will usually bulge downwards in the straining efforts of the infant to defecate, and a linear or crucial incision, with possibly excision of a part of the membrane, will give the requisite relief. If the septum be higher up, then division of the posterior wall of the anal passage may be requisite to bring it into view. If the anus be absent, or if a considerable thickness of tissues intervene between it and the rectum, a more troublesome operation will be requisite. The child should be placed in lithotomy position with the buttocks well raised, and, the bladder having been emptied by a catheter, an incision should be made in the median line backwards from the margin of the anus, if present, or from the normal situation thereof, if absent, and the dissection carried upwards in this plane, if necessary, along the concavity of the coccyx. If by this dissection the lower end of the bowel can be exposed, two sutures should be passed, first through one margin of the skin-wound, then across the bowel, and next through the other margin of the skin. The bowel should then be incised, the loops of suture drawn down and divided, and the bowel thus secured by four sutures to the skin. If this dissection should fail to expose the bowel, firm pressure should be made on the abdomen; and if this convey to the finger of the operator pressed into the perineal wound a distinct sensation of bulging, so as to indicate the near proximity of the bowel, the cartilaginous portion of the coccyx may be removed, so as to give more room, and the dissection continued a little higher. If the bowel can be thus brought into view, an attempt should be made, as before, to secure it to the skin, as otherwise a stricture will be inevitable.

But if this prove impossible, the bowel must be incised *in situ*, and the surgeon must endeavour, by the introduction from time to time of laminaria bougies, to keep the passage patent. If abdominal pressure, however, give no satisfactory indication of the proximity of the bowel, it is better to cease from any further perineal exploration, and to make an artificial anus. This may be done by Amussat's operation in the left loin, or by Littre's operation in the left groin. Amussat's operation is by no means easily performed on the infant, from the limited space in which the surgeon has to operate, and the difficulty of maintaining cleanliness with an artificial anus in this position is much greater in the infant than in the adult. Littre's operation is free from both of these objections, and may be performed as follows:—An incision, an inch in length, should be made in the abdominal wall, commencing a finger's breadth internal to and on a level with the left anterior superior spinous process of the ilium, and extending downward parallel with Poupart's ligament. The skin, fasciæ, and aponeurosis of the external oblique muscle having been divided, the fibres of the internal oblique muscle must next be carefully scratched through, as a muscular branch of the deep circumflex iliac artery always passes at this place between the internal oblique and transversalis abdominis muscles. The transversalis muscle and fascia must next be divided, when the sigmoid flexure may, if distended with meconium, as is usually the case, bulge into the wound.

If, from intra-uterine peritonitis, the peritoneal surfaces are adherent, this cavity will not be opened, and the projecting bowel should be at once attached to the skin wound by half-a-dozen sutures; but if the bowel is not distended, or if it is empty and collapsed, as may happen when the operation has been postponed for some days, and there has been persistent vomiting, the peritoneum must be divided and the bowel, if requisite, drawn forward and secured as before, care being taken to include in the sutures the divided edges of the parietal peritoneum. A linear incision of about half-an-inch in length should then be made in the bowel, and the edges secured by sutures to the skin wound. Starch-powder will protect the skin from irritation, and a pad of tenax may be used to receive the fæces. In some cases the sigmoid flexure is so distended as to lie in the right iliac fossa; but statistics of cases that have been examined after death prove that this does not occur so frequently as to justify operating on the right side in the first instance, when the probability of opening the cæcum will be very great.

If there be a recto-vesical or urethral communication, and if it be impossible to effect an opening from the perinæum, Littre's operation should be performed, to divert the course of the fæces and allow of the possible closure of the abnormal channel. Subsequently, by the introduction of a probe through the artificial anus, the course and extent of the bowel may be explored with the view, if possible, of making an opening in the perineum.

If there be a recto-vaginal or uterine communication the child will not be in any immediate danger, provided that the aperture be large enough to admit of a free discharge of fæces; but as such a channel has a natural tendency to close, an attempt should always be made to establish an opening in the normal region. If this fail, and the abnormal passage diminish so as to cause obstruction, it may, if accessible, be dilated, or Littre's operation be performed.

No rule can be laid down as to the treatment of fistulæ in other parts of the body. They are very rare, and each case must be decided on its merits.

The prognosis will depend on the condition of the child and the nature of the obstruction. If the child be otherwise well developed, and the obstruction be due to epithelial adhesion or a membranous septum, the result of treatment will probably be good. This is true also of cases where dissection is requisite to expose the bowel, if this can be attached to the skin. When this is impossible, the passage of fæces over a raw surface, and the necessarily frequent introduction of dilators, will greatly diminish the chance of a successful result. Cases have been recorded of infants, on whom the operation for artificial anus has been performed, having lived to adult age. But these cases are few in number, and, according to the writer's experience of hospital patients, the infants have usually died within three months.

Jeremiah McCarthy.

ATROPHY.—Atrophy, when the result of simple senile decay, is of importance mainly as providing an index to the declining functional and nutritive activity of organs and tissues, and thus furnishing the surgeon with the knowledge that structures so affected are liable to suffer in unusual degree from the immediate and remote consequences of injury and disease. The wasting incidental to age may involve most or all of the tissues, but it is often concentrated on one or a few, notably the vascular system, the muscles, and the bones. In the arteries, fatty atrophy of the constituent elements is commonly associated with fibroid substitution and irregularly disposed calcification. From these combined changes the walls of the vessels lose their resiliency and contractility, and the calibre of the small and medium-sized arteries—in which the blood-pressure is not sufficient to cause dilatation—is diminished. The vasa vasorum, too, are implicated in the process, and not seldom their lumen is obliterated. The above-mentioned conditions constitute the chief anatomical factors of continued primary bleeding following wounds, of late recurrent hæmorrhage after ligature, and of dry gangrene. Fatty metamorphosis of the heart, and of the cornea (arcus senilis) is a frequent concomitant of arterial degeneration. *See* Arteries, Diseases of.

In the fragilitas ossium of old people, the rind of compact tissue is attenuated, and the cancellous structure rarefied, whilst the spaces are filled with fat. An example may be seen in the neck of the femur, which is shortened and set at a more acute angle with the shaft—circumstances which favour the occurrence of intracapsular fracture from slight and indirect violence.

Another familiar instance of senile atrophy of bone is seen in the edentulous lower jaw.

In a few instances atrophy takes place apart from obvious degenerative change in the tissue-elements—e.g. as the glandular acini of the breast shrink on the cessation of lactation, the epithelial cells which line them simply waste away without their protoplasm being converted into molecules of fat; and again, as the contents of the fat-cells disappear in starvation they are often replaced by a clear fluid, which gives rise to a serous œdema of the cellular tissue, a condition well-known to pathologists as co-existing with emaciation, but the process is one of infiltration and not true metamorphosis. In the majority of cases, however, *the mode of atrophy* is apparent, being effected or accompanied by one or more of the various forms of degeneration. Thus, in the development of arcus senilis, and in senile rarefaction of bone, the connective tissue cells are converted into fat, and in inflammatory disintegration both fat and mucoid material are found in abundance, as may easily be seen in caries. Lastly, as nutrition fails in the arteries, and in the rib-cartilages, the parts become petrified with lime-salts; calcification, in short, when it occurs, is the final stage, and its result the abiding mark of the spoiling of tissues.

Atrophy of an organ is always accompanied by a proportionate loss of function. The bulk is at the same time usually, but not invariably, diminished. A bone may be so fragile as to break on the application of very slight force (spontaneous fracture) and yet it may retain its normal size. This is known as eccentric atrophy. More rarely there is actual enlargement of the part in spite of the atrophy of its special histological elements; thus, whilst the muscles of the calf are fast losing their contractile fibres, fat may be infiltrated into the cells of the interstitial tissue in quantity more than sufficient to make up the deficiency. Fatty substitution attains its maximum in these cases of pseudo-hypertrophic paralysis. Atrophy is termed *essential* when it happens without any assignable local cause—e.g. fatty degeneration of the corneal corpuscles, and of the endothelial lining of arteries. It is called *secondary* when due to some manifest means of disturbance of nutrition either by direct interference with the circulation, or indirectly through partial or total abrogation of function. Atrophies from continuous pressure come under the former category, those arising from disuse of a part under the latter.

CAUSES AND VARIETIES OF ATROPHY.—(1) *Physiological Atrophy* — 'Development and growth, maintenance and repair, decline and death, together with the discharge of function, make up the sum total of the life-history of all the tissues.' After parturition the *uterus* undergoes involution, or reversion to its quiescent state, from atrophy of its muscular fibre-cells, many of which are removed by absorption subsequent to molecular disintegration. At a certain epoch the *thymus* gland is subject to atrophy. Later on a similar fate awaits the *thyroid body*, in which colloid degeneration of the epithelial cells within the acini is a conspicuous feature. It is an interesting fact that the normal retrograde metamorphosis is not unfrequently disturbed, disorderly hypertrophy masking the intrinsic atrophy, so that instead of the bulk of the organ being lessened it is increased. Senile atrophy stands, as it were, on the frontiers of health and disease. In its incidence it is physiological, in its progress it becomes pathological; partly by reason of other changes being linked with it, and partly because the various systems and organs are not affected in like degree nor even simultaneously, there is a disturbance of the metabolic equilibrium of the tissues.

(2) *Atrophy from Diminished Function* is exemplified in the wasting of paralysed limbs; in the shrinking of muscles and the partial absorption of bones concerned in an unreduced dislocation; and in the loss of substance which gradually ensues in a stump after amputation.

(3) *Atrophies of Nervous Origin.*—There can be no doubt that when the innervation of a part is disorderly or absent, certain errors of nutrition are liable to supervene, and amongst them is atrophy. In no other case is it more manifest than when a nerve-trunk is severed. The distal portion dwindles away, as the white substance of Schwann is removed by absorption. Meanwhile the consistence of the nerve is sensibly diminished, so that in the operation for effecting union of the segments the difficulty of retaining them in apposition, under tension, increases in proportion to the length of the interval that elapses between the infliction of the injury and the attempt to repair it. *See* NERVES, Injuries of.

One of the most prominent features of Charcot's disease of the joints is the erosion of the articular surfaces of the bones; the head and neck of the femur, for instance, have been found absent. By some pathologists it is contended that the atrophy is entirely owing to excessive friction, or in other words that the influence of the nervous system is merely permissive, the normal check upon movement of a diseased joint being annulled, owing to the analgesia of the limb. The balance of evidence, however, seems to be in favour of the hypothesis which supposes the wasting to be in some measure directly due to perverted function of the nerves. *See* CHARCOT'S DISEASE.

The degree of atrophy of the muscles in caries of joints varies within considerable limits. In cases where the pain is severe and lasting it is often surprisingly marked, both as regards extent and rapidity; not that the atrophy is so much the immediate consequence of the pain, as that the latter is the indication of active disturbance of normal innervation.

(4) *Atrophy from Partial Deprivation of Blood-supply.*—There are several ways in which this result is worked out:—(*a*) The nutrient artery of a long bone may be compressed by a tumour or torn through in fracture; (*b*) or the obstruction may be on the venous side of the circulation, the proper renewal of arterial blood being prevented; wasting of the testicle from varicocele, and of the liver-cells in portal and systemic venous congestion, are apposite examples. Under such conditions an ill-developed form of fibrous tissue supplants the more highly specialised elements, and, contracting, strangles the smaller vessels—an additional source of atrophy. (*c*) In atrophy of the hard palate from a badly-fitting obturator, and of the kidney from impaction of a calculus in the ureter, the pressure is diffused and acts alike on arteries, veins, and capillaries. Cornil and Ranvier have shown that there is something

more than simple absorption from starvation, for the tension on the tissues sets up inflammation, which is rarefying in the more exposed parts, whilst it is condensing in the deeper. Thus after maceration of vertebræ excavated by an aneurism, the eroded bone is seen to be closer in texture than normal cancellous tissue. AUGUSTUS J. PEPPER.

AUDITORY NERVE. *See* EAR, INTERNAL, Diseases of the.

AURAL EXOSTOSES.—Aural exostoses of the nature of spongy osteomata are the most frequent form of bony tumour in the ear, and are definable by the following characteristics:—They are usually pedunculate, may be somewhat movable, occur singly, and at any point in the meatus, very rarely in the tympanum, but commonly at the junction of the cartilaginous and osseous portions; are of rapid growth, and are associated with suppuration; may be preceded by polypus, and are often developed, by ossific growth, from polypoid granulations; and can be removed by simple operative measures. On microscopic section they show a structure similar to that of newly formed bone, with the free surface bounded by a finely papillate fibrous membrane coated with squamous epithelium, and the osseous trabeculæ constituting a framework for a vascular medullary tissue, containing, in the most internal portions, spindle in addition to round cells.

Other growths, of compact but not ivory-like consistency, constitute the majority of the multiple exostoses. Microscopically they resemble syphilitic nodes of the cranial flat bones. Within their epithelial and fibrous investment are seen, at right angles to the surface, somewhat irregular Haversian canals of periosteal origin, containing blood-vessels; these canals are fewest in the more compact, slow-growing tumours.

Ivory aural exostoses, or, rather, hyperostoses, occur in the form of a ridge-like protuberance, or as one or more rounded broad-based tumours, usually on the posterior wall and near the orifice of the external meatus, are neither of congenital nor of active inflammatory origin, are of slow growth, and are commonly met with in both ears. They are more frequent in the male than in the female sex. Externally they are covered with a smooth, hairless insensitive cutis. Of extreme hardness, they present microscopically the characters of excessively dense bone. The external squamous and fibrous coating is thin, and contains few and small vessels. The bony lamella, between which lie lacunæ with blood-corpuscles, do not follow the course of the vessels, but run parallel to the surface, at right angles to which usually pass the canaliculi. Vessels are perceptible, as a rule, only where at its base the tumour becomes continuous with the temporal bone.

Etiology of aural exostoses.—Assigned causes for aural exostoses in various cases are partial hyperplasiæ during the stages of development of the osseous meatus, occurring in the form of small symmetrical, comparatively innocent, bilateral osteomata (Politzer); circumscribed and diffuse inflammation of the external meatus; heredity, which, or else mechanical irritation, may account for the frequency of aural exostosis among the aborigines of America, as evidenced by their skulls; and syphilis, gout, and rheumatism. In nearly all instances of double ivory exostosis, mechanical irritation due to habitual sea-bathing seems to have been the initial cause.

Rate of Growth.—The compact aural exostoses are the most slowly formed; and the spongy osteomata, as one might infer from their larger vascular supply, are of comparatively rapid growth. It would be somewhat difficult to arrive at an approximate estimate of the rate of development of the ivory exostoses, as their existence in the ear is commonly overlooked until they cause uneasiness by pressure on the meatus, and interfere with audition.

Treatment.—For the removal of exostoses the gouge or, in the case of pedunculate growths near the orifice of the outer ear, the gouge and mallet have been recommended. The galvanic cautery, the chain-saw or écraseur, the trephine used in places for the induction of caries, polypus snares, and dentist's forceps, have all, with more or less success, been resorted to. Bonnafont's method of establishing the patency of the meatus by the introduction of a plug between its wall and the contained tumour is barely practicable, according to the writer's experience, on account of the intense pain it gives. Von Tröltsch's prolonged dilatation with laminaria tents seems scarcely more satisfactory as a radical mode of dealing with the obstruction to hearing caused by an exostosis. The use of a dentist's drilling machine, first suggested by Dr. Matthewson, of New York, for the channelling of the very hardest ivory exostoses, has been found productive of eminently good results.

For the ready and safe performance of the operation, however, there are several requisites, namely, a couch for the patient sufficiently high to permit of the proper application of the drill, a steel guard to fit round the exostosis and to protect adjacent parts, drills of various sizes and shapes for the gradual enlargement of the opening to be made, and assistants to work the treadle of the machine, to administer an anæsthetic, to hold the steel guard in position, and to sponge or syringe-out blood effused in the meatus. It is highly important to begin the drilling operation close to the guard, as thereby the exact direction in which to work is ascertained, and always to proceed with both slowness and caution. The subsequent treatment of the patient resolves itself, usually, into combating, if necessary, the effects of secondary inflammation. Granulations in the meatus sometimes retard recovery. For these tannic acid is a useful astringent; and Dr. Victor Bremer, of Copenhagen, recommends the application of pin-shaped pieces of *Laminaria digitata.*

In the case of multiple exostoses, drilling is usually unnecessary, as, in consequence of mutual pressure and interference with growth, these usually leave a passage in the meatus sufficient for the transmission of sound: this, if blocked with cerumen or a polypus, is not cleared without difficulty. By the use of bone-forceps, which may be preceded by drilling, aural exostoses, other than the ivory-like growths, may in many instances be very readily removed. In one case operated on by the writer, a dentist's elevator served to sever the tumour from its base.

The possible importance of prompt perforation or removal of an aural exostosis has been illustrated by several examples of death, owing to the imprisonment of discharges through stenosis of the meatus. Obviously an operation for the removal of exostosis is indicated in all cases of otherwise irremediable deprivation of hearing.

G. P. Field.

AURICLE. *See* Ear, External, Diseases of the.

AXILLA.—The deep and roomy axillary cavity is one of considerable surgical importance, as it transmits the large blood-vessels and nerves of the upper extremity and contains numerous glands in connection with the lymph-ducts of this limb, and of the walls of the chest and abdomen. These structures are packed in a mass of lax connective and adipose tissue, which may be readily infiltrated by a large quantity of effused blood or inflammatory exudation, and offers but slight resistance to the expansion of any rapidly growing tumour. The anterior or pectoral wall, with its broad level surface, is formed in great part by the pectoralis major. Along the well-marked inferior border of this wall, or just behind it, are situated some lymph-glands, which are usually the first to become infiltrated in cases of cancer of the breast; and at its upper and outer limit is the interspace between the pectoralis major and deltoid muscles, which may be obliterated by effusion within the capsule of the shoulder-joint, and through which the pus of a deep axillary abscess sometimes comes to the surface. Near the unyielding inner wall, formed by the first four ribs and the serratus magnus and intercostal muscles, will be found the nerve of Bell and a chain of deep-seated glands, which receive lymph-vessels from the breast and the front of the chest, and of the abdomen above the level of the umbilicus. At the outer part of the cavity, bounded by the upper extremity of the humerus and the coraco-brachialis muscle, is the large vasculo-nervous cord formed by the axillary artery with its vein and the nerves of the brachial plexus. Here is another set of glands which are liable to become enlarged in cases of inflammatory irritation or specific inoculation on any part of the surface of the upper extremity.

The back of the cavity is securely closed by the scapula and the subscapularis and other muscles; and here, in connection with the subscapular artery is a third set of glands, which are connected with the lymphatics of the back of the chest. Through the open apex of the axilla, bounded by the clavicle, the scapula, and the first rib, which transmits the large vessels and nerves from the neck to the upper limb, blood, pus, and other inflammatory effusions, and even rapidly growing and infiltrating tumours, may spread from one region to the other. The large quadrangular base of the cavity is covered by thin, soft, and very sensitive skin, studded by long fine hairs, and abundantly supplied with sebaceous and sweat-glands. As a result of its situation and structure this portion of the general integument is a frequent seat of boils, of small superficial abscess, and of inflammatory eruptions due to direct irritation.

The chief point of interest in connection with the deep fascia of the axilla is its disposition in two layers, one connected with and enclosing the pectoralis major, and the other and deeper layer enclosing the pectoralis minor, and being continuous above with the costo-coracoid membrane, and below with the so-called suspensory ligament of Gerdy, which plays an important part in cases of deep-seated axillary abscess. The large vascular trunks as they pass through the cavity, are surrounded by the brachial plexus, which here begins to spread out, the median nerve passing almost directly downwards to the inner side of the arm; the musculo-cutaneous nerve being directed outwards and downwards; the ulnar nerve inwards and downwards; and the musculo-spiral and circumflex nerves backwards and downwards. The thick and strong cords of the plexus are rarely torn through, save in cases of very severe injury, but are often compressed in cases of luxation of the head of the humerus, and also during the growth of a large tumour. The nerve which is mainly, if not exclusively, affected in instances of 'crutch paralysis' is the musculo-spiral.

The axilla, which is traversed by numerous branches from the main blood-vessels, is readily infiltrated and occupied by effused blood in cases of fracture and other injuries. In rapidly expanding tumours of the axilla this space is soon obliterated, the growth tending to extend most freely downwards, so as to project beyond its base and to separate the arm from the side of the chest. In sub-coracoid luxation of the head of the humerus the upper part of the space is occupied by the displaced bone.

Acute cellulitis of the axilla may occur either as a localised affection, or in association with a like condition of the arm or the whole of the upper extremity. In the former instance it is usually the result of inoculation with some septic virus, and is marked at first by deep-seated pain in the axilla. The integument soon becomes red and œdematous. As a rule this inflammatory affection is remarkably rapid in its progress, and the zones of invaded connective tissue rapidly undergo sloughing. The constitutional symptoms are generally very severe, and the patient often passes into a condition of intense septicæmia.

Circumscribed suppuration in the subcutaneous connective tissue of the armpit —*superficial axillary abscess*—may be due to local irritation, to lymphangitis, or intense cachexia. The abscess consists in a rounded fluctuating swelling, which is very tender and covered by tense and highly congested skin. In a case of this kind a free incision should be made at an *early stage*, in order to prevent penetration of the pus into the deeper portions of the axilla, and the formation of one or more obstinate sinuses.

Deep-seated axillary abscess may be acute or chronic, and again, either primary and dependent on some local cause, or secondary and due to the spreading of pus from some other region. A purulent collection in the axilla may be part of a larger abscess due to suppuration in the neck, to necrosis of the scapula, or to disease of the shoulder-joint. Instances have been recorded of empyema which had perforated the thoracic walls so as to produce a deep axillary abscess.

Primary acute abscess of the axilla is often the result of septic absorption, but may arise spontaneously or from contusions or sprains. The most frequent cause, however, is sympathetic glandular inflammation, excited by some wound or scratch or an open sore on the hand or breast. Whatever may be the cause of deep-seated abscess in the axilla, the arrangement of the fasciæ met with in this region plays a very important part in the seat of the purulent collection. The so-called suspensory ligament of the axilla formed by the process of fascia, which, after having enclosed the pectoralis minor, is inserted into the floor of the cavity, influences, at any rate in the earlier stages, the course taken by the pus. Hence, owing to this lamina, there are two forms of deep axillary abscess—one beneath the pectoralis major, the second at a greater depth, and beneath the pectoralis minor. In the former case the pus would make its way to the anterior border of the axillary fold, or in the furrow between the deltoid and pectoralis major. In the latter case, the pus, being bound down by the clavi-pectoral fascia, would have a tendency to surround the vasculo-nervous cord and to ascend into the neck, and might there infiltrate extensively the cellular spaces, and ultimately spread through the superior aperture of the thorax into the anterior or posterior mediastinum. There is often a tendency for the pus to burrow beneath the latissimus dorsi and into the subscapular fossa, and in some instances it has been known to extend as far as the brim of the false pelvis.

But few points of special import have to be mentioned with regard to the treatment of deep-seated abscess of the axilla. Suppuration being clearly indicated, it is necessary to afford vent to the pus without delay; and, after making an incision, it is well to use a director and dressing-forceps, as in other cases of opening a supposed abscess which is situated at some depth from the surface, and in the midst of important vessels and nerves. As the abscess-cavity contracts, care should be taken to keep the arm at rest and in contact with the side of the chest, as healing may be retarded by free movement of the limb, and fistulous tracks thus be established.

The most frequently observed of the many forms of *Glandular swelling* in the axilla are:—simple, acute, and chronic adenitis, strumous and syphilitic enlargements, secondary cancerous infiltrations, and lymphadenoma. Swellings of an inflammatory character, if acute, may in most instances be readily recognised, and usually there is evidence of some lesion of the lymphatics of the hand or of the thoracic or abdominal parietes. Such swellings do not of necessity run into suppuration. With chronic adenitis there is usually associated some well-marked cachectic condition. Syphilitic adenopathy, when occurring in the axilla, consists in the usual marked induration and slight enlargement of a few separate and freely movable glands, and is thus distinguished from the large lobulated and softened masses formed by the coalescence of glands undergoing strumous degeneration. Lymphadenoma, which often co-exists with like growths in other regions, presents a large and rapidly-growing but painless tumour of firm and elastic tissue, and with a generally smooth surface, marked at one or more parts by distinct lobular projections. The glands most frequently affected in cases of cancer of the mamma are those situated along the lower border of the pectoralis major and on the inner wall of the cavity near the superior digitations of the serratus magnus.

The *Tumours* met with in the axilla are mostly of glandular origin, but other forms of new growth occur, which either spring from adjacent bones or originate in the soft and proper structures of the cavity. Of the former the most frequent examples are hard (exostosis, enchondroma) or soft (carcinoma, sarcoma) growths originating in the scapula, the upper part of the humerus, or a rib. Of the second class of tumours many varieties have been observed—such, for instance, as cystic, lipomatous, fibrous, fibro-cystic, erectile, and primary sarcomatous growths. To these may be added a few instances of new growths connected with the nerves of the brachial plexus, such as neuromata and cysts. A very frequently noted characteristic of axillary tumour, even when of a very benign character, is rapidity of growth and consequent size, the large and loosely-packed cavity of the armpit favouring free expansion of the new growth, which in the early stages of the development causes but little if any disturbance, and is concealed by the pectoral muscles and the scapula. In almost every case of large or rapidly-developing tumour of the axilla, the attention of the surgeon is directed to a series of symptoms due to compression of the axillary blood-vessels and of the cords of the brachial plexus.

The subject of the *operative removal of axillary tumours* is one of much importance. A small and freely movable growth may in most instances be excised readily and with little danger. With regard to large growths which occupy most of the cavity and protrude beyond its inferior limits, the question of excision will be influenced by the diagnosis as to the nature of the tumour and the extent to which the large vessels and nerves, and also the integument, are implicated. Very large fibrous, fibro-cystic, and cystic growths have been successfully removed from the axilla, and in most cases of such forms of tumour operative interference may be considered as justifiable if the patient be in good condition. In lymphadenoma of the axilla the enlarged glands, according to Erichsen, form no attachments to surrounding parts, and may be readily removed by enucleation. The attempted removal of a very large lobulated lipoma or enchondroma is likely to be attended with much difficulty and risk, in consequence of the irregular extension of the growth around large vessels and nerves and into other regions. In the case of a very large, rapidly-growing, and fixed tumour, associated with considerable œdema of the upper extremity and indications of obstructed circulation and nerve-compression, the probability of a successful extirpation would be small, as both artery and vein, together with the cords of the brachial plexus, would almost certainly be found implicated in the disease. No attempt should be made to remove a large sarcomatous tumour, especially when the skin is ulcerated.

The enucleation of enlarged strumous glands from the armpit is usually a tedious and difficult operation, and is hardly justifiable, except in the rare instances in which the patient is in good condition and the glandular disease is very troublesome, rebellious to ordinary treatment, and limited to the axillary region. In the operative treatment of carcinoma of the breast, careful dissection of the axillary cavity and enucleation of both enlarged and apparently healthy glands have of late been advocated by many English and German surgeons. In operations of this kind, and also in the removal of any large axillary tumour, it will often be found necessary to make partial or complete division of the pectoralis major. The great danger is wound of the axillary vein or some large tributary. The knife should be laid aside as soon as possible, and the finger-nails and blunt instruments used to dislodge the growth, the surgeon taking care not to tear it away rashly and with too great force, as large venous trunks may be readily lacerated.

Wounds of the Axilla.—Serious direct and penetrating wounds of this region are not often met with, the cavity, especially when the arm is near the chest, being well protected on every side. In most instances of deep wound of the axilla, associated with division of a large vessel or nerve, the cause is a gun-shot wound, a sword-thrust, or a stab with a knife or dagger. A deep punctured wound, implicating merely a small arterial or venous branch, may, in consequence of the laxity of the axillary connective tissue, cause considerable effusion of blood and temporary distension of the cavity. In the case of a deeply penetrating wound, the absolute diagnosis as to whether the main trunk or a branch has been divided is uncertain and difficult. If the bleeding is very copious and the wrist-pulse cannot be felt, the main artery has very probably been wounded. The radial pulse, however, sometimes persists, though much weakened, in cases of partial division of the axillary artery. If there be much swelling and lividity of the upper extremity, with congestion of the superficial veins, the pulse being still perceptible, the injured vessel is very likely the axillary vein, although this is much less frequently wounded than the artery. If the hæmorrhage, at first severe, ceases or decreases, and the radial pulse can still be felt, the chances are that some large branch, either arterial or venous, has been wounded. Numbness of the upper limb, with more or less marked and diffused paralysis in connection with a punctured wound of the axilla, indicates a lesion of one or more large nerves.

In wounds of the axillary artery or one of its large branches, the results vary in different cases according to the extent of injury to the vessel and the nature of the wound in the skin and other structures of the axilla. Here, as in any other region traversed by a large arterial trunk, there may be very profuse and rapidly fatal hæmorrhage from a wide wound, freely exposing the injured vessel; or there may be repeated effusion of large quantities of arterial blood into the space in connection with a long and very narrow puncture, or, again, temporary arrest of the bleeding, with the formation, after a certain interval, of an arterial or arterio-venous aneurism. Two instances have been recorded of spontaneous cure of division of the axillary artery, but such a result must be very rare.

Treatment.—In the event of spontaneous arrest of hæmorrhage in penetrating wound of the axilla, it is better not to interfere at all, but to keep the patient quiet and carefully watch for any symptoms of arterial injury that may occur. Pressure, if it readily arrests the bleeding, should be gently and carefully maintained. In cases of free and persistent bleeding from a large open wound, or of rapid infiltration of the soft parts under the skin and fascia, an attempt should be *promptly* made to secure the artery at the seat of injury. The subclavian artery being commanded just above the clavicle by pressure, a steady dissection should be made down upon the wounded vessel, the surgeon being guided by the position of the external wound. If on free division of the infiltrated structures and removal of clots, the artery can be exposed at the seat of injury, this should be secured by two ligatures, one above, the other below, the wound, and the vessel, if not completely divided, be cut through between the points of ligature. The difficulty of finding the wounded artery may be so great, and the symptoms so urgent, as to lead the surgeon to have recourse to ligature of the subclavian in the third part of its course. The results of this operation, however, under such circumstances, have hitherto proved very unsatisfactory, and except, probably, in instances of but a small puncture of the axillary artery or one of its branches, it has almost always been followed by a renewal of the hæmorrhage. On failure of this procedure, amputation at the shoulder-joint will afford the only chance for the patient.

For the treatment of the remote results of wound of the axillary artery, *see* Axillary Artery, Aneurism of the.

Wound of the *axillary vein*, may, though rarely, be produced in any of the ways already mentioned, but most frequently occurs during the removal of a large tumour from the axilla. Sometimes only a branch is divided or torn by the surgeon; but this, when the injury occurs near the junction of such branch with the trunk, is as serious a condition as a wound of the main vessel itself. Such wounds are dangerous on account, not only of hæmorrhage, but of the entrance of air into the vein. Immediately profuse bleeding from a large vein is detected, a ligature should be applied. Should the main trunk be much wounded, it ought to be secured by a double ligature. Such practice, however, unless applied under antiseptic conditions, is not free from danger, as phlebitis and pyæmia may be thus produced.

Simultaneous wounding of both axillary artery and vein, though a serious injury, does not necessitate primary amputation at the shoulder-joint. Indeed, several records of this double injury seem to indicate that the patient is in a somewhat more favourable condition than after wound of only the artery. The hæmorrhage, according to Böckel, may soon cease, and an arterio-venous aneurism result, which may be more favourably dealt with than a large false or traumatic aneurism. *See* ARTERIO-VENOUS ANEURISM.

A subject of much interest in connection with axillary injuries, is that of wounds of large vessels in certain cases of dislocation of the head of the humerus. Such injury may occur in a recent case of uncomplicated dislocation, even when no attempt at reduction has been made; in a case of dislocation complicated by fracture; or—and these are the most frequent instances—in cases of old dislocation, treated either by very forcible extension or extreme abduction and elevation of the upper limb. The vascular lesion consists usually in either complete rupture of the axillary artery, or in separation of one of the large branches close to its origin. Some instances have been recorded in which the injured vessel was the axillary vein, and in some few serious hæmorrhage was caused by the rupture of several small arterial and venous branches. In those cases in which rupture of the axillary artery is caused simply by elevation of the arm in an attempt to reduce an old dislocation, some special conditions must exist to account for the injury; for the proportion of these unfortunate instances to those of successful reduction by much force of a dislocation of very long standing is very small. These conditions, it has been stated, are degeneration of the arterial walls and firm adhesion of the displaced extremity of the humerus to the surrounding parts, especially to the large vessels. In a collection of thirty-one cases published by Mr. Callender, in 1866, all the patients save one were over fifty years of age; but in a more recent and fuller table published by Dr. Körte, of Berlin, fifteen out of forty-eight patients were under this age, and six of these were between twenty and thirty years of age. In cases in which the luxation is quite recent, the vascular injury is due either to direct action of the head of the humerus, to unnecessary violence in reduction, or, in complicated dislocation, to a puncture by the sharp end of a fragment of bone. *See* ARTERIES, Rupture of.

In some cases of ruptured axillary artery the blood is poured out very rapidly into the subcutaneous soft parts of the axilla and chest and back, and the patient dies within an hour; in other cases a well-marked traumatic aneurism is developed within a few hours or days after the injury; and in others, again, the swelling is formed very gradually, and is not observed until after a considerable interval.

The prognosis in cases of this injury is most unfavourable, especially when the dislocation has been of long standing and the patient is advanced in years. According to Körte, who has studied this subject very carefully, in cases of small tumour not presenting the characteristic signs of an aneurism, the most suitable treatment is complete rest of the limb, with pressure over the axilla, the patient being carefully watched. In cases of rapidly-developed and undoubted aneurismal swelling, antiseptic ligature of the subclavian artery would offer the best, but a slight, chance of success. If the tumour have existed for some time, and its pulsation is not arrested by pressure on the subclavian artery, the only possible operative treatment would be incision of the tumour and double ligature of the wounded artery. EDWARD BELLAMY.

AXILLARY ARTERY, the, extends from the outer border of the first rib, whence it passes with a gentle curve across the upper part of the axilla, to end at the lower border of the teres major muscle. The artery is divided into three stages by the pectoralis minor.

1. The stage above the pectoralis minor, or first stage, passes from the first rib to the upper border of this muscle. In front are:—the skin, superficial fascia, platysma, and descending branches of the superficial cervical plexus, deep fascia; the pectoralis major, beneath which is a triangle—the clavi-pectoral—overspread by the clavi-pectoral or costo-coracoid fascia. Through the fascia pass the acromio-thoracic artery, the cephalic vein, and the external anterior thoracic nerve. On a plane anterior to and below the artery is the subclavian vein; behind and above, the cords of the brachial plexus; internally, the serratus magnus.

Ligation.—Three methods of incision are in vogue. 1. A semilunar from near the sternal to near the acromial end of the clavicle. 2. A straight incision along the clavicle with similar limits, to which a second vertical incision is added, separating the deltoid from the pectoralis major. 3. A vertical incision alone, separating the two last-mentioned muscles. The first-mentioned incision, commencing just below and external to the sternal end of the clavicle, is made by a sweeping cut downwards, ending at the anterior border of the deltoid. The coverings mentioned above are cut through, severing the pectoralis major from the clavicle. Feel for the edge of the pectoralis minor when the shoulder is pressed backwards, and pushing the finger still further backwards, recognise the pulsations of the axillary artery. Push the shoulder forwards, clear the artery of cellular tissue, and avoiding the vein in front and the cords of the plexus behind, pass the needle from before backwards, and obliquely from within outwards.

2. The second stage of the artery, that beneath the pectoralis minor, has this muscle in front; the vein internally and below; the cords of the plexus begin to surround the artery, but are still placed for the most part behind.

Ligation at this stage is performed by cutting, in the line of the artery, through everything till the artery is reached.

3. The third stage, or that beyond the pectoralis minor, ends at the lower border of the teres major muscle, i.e. some distance down the humeral shaft. In front are the cutaneous structures, and the pectoralis major for a short distance above; behind it rests on the subscapularis, latissimus dorsi, and teres major; internally and below is the vein. The cords of the brachial plexus are named outer, inner, and posterior, according to their relations to the artery; the median nerve lies in front.

Ligation.—Place the limb in the position of abduction, and rotate it outwards. The artery is found at the junction of the anterior and middle thirds of the axilla from before backwards, just under cover of the bulge of the coraco-brachialis. Make an incision along this line for three inches, cutting skin only; raise and divide the deep fascia upon a director. Pull the axillary vein backwards, when the nerves associated with the front and inner side of the artery appear. Draw the median nerve forwards, the internal cutaneous and ulnar nerves backwards, expose the artery, and pass the needle from behind forward.

James Cantlie.

AXILLARY ARTERY, Aneurism of the.—Aneurism of the axillary artery is probably met with more frequently than that of any other large artery save the popliteal, but, in the majority of cases, is due more to injury than to arterial disease. The tables that have been formed of recorded cases of this affection all include a number of instances of traumatic axillary aneurism from wound, laceration, or rupture, and of aneurism following a blow on the shoulder. As might be concluded from these facts, axillary aneurism occurs much more frequently in males than in females (12 to 1), and is more often met with on the right than on the left side. In fifteen cases collected by Mr. R. W. Parker, of spontaneous external aneurism in persons under the age of twenty, one only is included in which the axillary artery was affected.

There are certain special points to be noted with regard to the signs and symptoms of a typical axillary aneurism. In the first place, the swelling, as a rule, increases very rapidly. To the expansion of an aneurismal sac, as to that of a rapidly growing tumour, but little resistance is offered by the lax cellular tissue of the axillary space, and, in the course of six weeks or two months, a large and very apparent pulsating tumour may be developed. The tumour springs most frequently from the lower part of the artery, and projects directly downwards between the folds of the cavity. In cases where it arises from a higher part of the artery, it has a tendency to project upwards towards the clavicle, and occasionally even into the posterior triangle of the neck. The elevation of the shoulder so often observed in cases of large aneurism in the axilla is due, partly to pressure of the sac on the lower surface of the clavicle, and partly to constant voluntary efforts made by the patient to relieve compression of the cords of the brachial plexus. The sac of a large axillary aneurism may cause serious lesions both to the walls and contents of the cavity, and much disturbance in the blood-supply and innervation of the upper limb. The clavicle, or the first two or three ribs, may be eroded, and the sac, Böckel states, may project into the thoracic cavity or open into the shoulder-joint. The pressure of the sac on the nerves, as in cases of large solid tumours, causes numbness of the upper extremity and severe neuralgic pains. Owing to obstruction of the circulation through the axillary vein, the whole limb becomes congested, œdematous, and cold. The disturbance in the flow of blood through the artery may cause considerable diminution, or even complete arrest, of the radial pulse, and some loss of muscular power.

The *diagnosis* of true axillary aneurism is not usually attended with any difficulty. Several instances have been recorded in which experienced surgeons diagnosed the swelling as an abscess, but in these the affection consisted in a large diffused aneurism of traumatic origin. The conditions most likely to be confounded with circumscribed aneurism in the region of the axilla are those of a large and soft malignant growth, and of osteo-aneurism of the upper extremity of the humerus. In the former instance the clinical history and general condition of the patient with regard to cachexia and rapid emaciation, and in the latter instance the starting-point and situation of the growth, will probably serve to render the diagnosis clear.

The *treatment* of axillary aneurisms, which up to 1860 had consisted almost invariably in the application of a ligature to the third part of the subclavian artery, has since been much modified in accordance with more recent views as to the risks of the Hunterian operation when applied to this affection, the condition of the artery at the seat of aneurism, and the advantages of digital compression. In 1860, Mr. Syme advocated a return to the old method of treating axillary aneurism by incising the sac and applying a double ligature to the affected artery. The risks of ligature of the subclavian artery must always be great in consequence of the proximity of the sac and the free collateral circulation; and the old operation, even in the hands of the most experienced surgeon, must be regarded as a very heroic and hazardous proceeding. Save when contra-indicated by large size and rapid expansion of the sac, and by extreme elevation of the clavicle, digital compression should always be tried in cases of circumscribed aneurism of the axillary artery. This method has been strongly advocated by Mr. Holmes, who is of opinion 'that there are a great number of axillary aneurisms, both traumatic and spontaneous, which are amenable to gradual, intermitting pressure, when carefully applied to the artery above the tumour, and that in cases where this is not possible, from the pain which the patient experiences on pressure, the application of rapid total compression, under anæsthesia, may effect a cure.' If compression should fail, the surgeon may then have recourse to ligature of the subclavian, or, in the presence of any insuperable difficulties in the performance of this operation, to the old method as advocated by Syme; or, if the aneurism be of considerable extent, to removal of the upper extremity at or near the shoulder-joint. In instances of ruptured artery and large diffuse traumatic aneurism, it will be found necessary to expose the vessel and to secure it by ligatures above and below the seat of injury. EDWARD BELLAMY.

AXILLARY ARTERY, Wounds of the. *See* AXILLA.

AXIS, Fracture and Dislocation of the. *See* BACK AND SPINE, Injuries of the.

B

BACILLUS.—A rod-shaped form of micro-organism, belonging to the class of Schizomycetes (q.v.) and forming the genus Desmobacteria of Cohn.

Most forms are several times longer than their breadth, and the protoplasm is usually continuous within the cellulose sheath; in a few it is occasionally interrupted. The bacilli possess all the characters common to the Schizomycetes, but reproduction is brought about not only by simple longitudinal extension, followed by fission, but also by spore-formation. By fission, one rod has been found to double itself in twenty minutes at 35° C. In reproduction by spore-formation, the rod usually extends into a long filament (*leptothrix*), in the protoplasm of which there appear at intervals bright spots, which soon develop into (oval) spores. By the rupture of the filament these are liberated, and develop into rods by an extension at one point of their protoplasmic body pushing outwards the hyaline covering or sheath. Many bacilli, however, do not form *leptothrix* threads, and spores appear in the protoplasm of the adult rod, the sheath of which bursts, and the spore is freed. The presence of oxygen appears to be necessary to spore-formation.

(1) The SAPRIC bacilli, of special surgical interest as occurring in putrefying fluids, are:—

B. subtilis, found in putrid hay infusions and grows readily in animal fluids, e.g. serum, &c.

B. ulna. A much larger form, being more than twice as thick, found in putrefying animal tissues.

B. sapricus. A non-motile form found shortly after death in human blood-vessels (Klebs and Bond).

B. butyricus, found in fluids in which butyric fermentation is going on.

(2) The PATHOGENIC bacilli are of the greatest importance, as several diseases have been clearly proved to be due to their mycotic action.

B. septicæmiæ. (a) Of mice, Koch. An exceedingly small organism found in putrid fluids. Œdema is produced at seat of inoculation, the spleen is swollen, and the rods are mostly found in the leucocytes. (b) Of man, Klein. Also small organism, but larger than (a), figured by Klein, as found in lymph glands.

B. anthracis. This organism forms the poisonous element in splenic fever in animals, and malignant pustule (q.v.) and woolsorter's disease in man. It is found throughout the blood cramming the small vessels, causing inflammatory changes in the respiratory passages and lungs, swelling of the spleen (sometimes), and occasionally intestinal lesions.

B. anthracis symptomatici. The 'quarter evil' of animals, in which a hæmorrhagic œdema is produced at the seat of inoculation and consequent death from sapræmia (q.v.). The effects are proportional to the number of bacilli injected.

B. of malignant œdema (Koch), found in putrid fluids (? a form of *B. sapricus*) &c. Causes gangrenous œdema, with swelling of spleen and parenchymatous organs, together with petechiæ in and inflammation of serous membranes. The writer has twice seen similar organisms in traumatic gangrene, with similar post-mortem appearances.

B. tuberculosis. (a) Of man (Koch). A small organism, the protoplasm of which often has a beaded appearance. Found in the giant cells and caseous masses of tubercular lesions throughout the body; and when cultivated, inoculations produce a similar disease. The presence of the bacilli in sputum affords a valuable aid to the diagnosis of fatal phthisis. (b) Of animals. A similar though smaller bacillus is found in tubercular lesions of animals, the same being macroscopically different from the disease in man. It is doubtful at present if this form is communicable to man.

B. lepræ (Hansen). A small bacillus presenting the same behaviour to reagents as the *B. tuberculosis*; is found in enormous quantities in the corpuscles forming the leprosy nodules and thickenings of connective tissues.

B. equiniæ. A small bacillus found in the nodules, &c., of glanders both in man and animals.

B. nomæ (Lingard & Batt). In spreading ulcerative stomatitis, bacilli have been found at the margin of the disease. Death appears to follow from sapræmia, produced by swallowing the putrid discharge, since the writer has found a progressive anæmia, &c., in a case of this disease.

B. of swine plague (Klein). In swine-plague, the organs throughout the body contain bacilli closely resembling *B. subtilis.* The lesions produced are swelling of the spleen, pneumonia, necrosis of small patches in the liver, &c.

B. malariæ. Organism found in blood of malarious patients, which inoculated into rabbits produced a fever said to resemble malaria (?).

B. of choleraic diarrhœa from putrid meat (Klein). An organism found in two important epidemics of diarrhœa, fatal in five cases. The organisms were rounded at ends, and ·003—009mm. in length. Inoculation on animals produced similar fatal disease.

B. of lupus. In lupus corpuscles, &c., is found a small bacillus, the relation of which to syphilis and tubercle remains unknown.

B. typhoidus. A short thick organism found in the lymph-glands and spleen, in cases of typhoid fever. It is of doubtful importance.

For *B. choleræ*, see *Vibrio.*

VICTOR HORSLEY.

BACK AND SPINE, Injuries of the.—Here, as elsewhere, injuries may be met with ranging from the most trifling to the most severe. But there is perhaps no class of cases in which early diagnosis is more often difficult, or prognosis uncertain, from the fact that the slighter degrees of injury to the spinal cord or the offshoots from it, may at first give rise to no symptoms, and may lead to a sense of security as to the future which a more certain pathological knowledge would have proved to be unwarranted. But although the graver injuries of the spinal column, its fractures and dislocations, are usually fatal, or cause lifelong incapacity from simultaneous damage to the spinal cord, there nevertheless are not a few instances where recovery has taken place, or life been prolonged in comparative comfort, even after spinal injuries of apparently the most hopeless kind. The greater boldness in treatment which has followed a more extended pathological knowledge has shown us that the once hopeless view entertained of all fracture-dislocations of the spine is not altogether warranted. Not a few cases are now on record in which the reduction of a displacement or dislocation of the spine has led to a speedy subsidence of the symptoms which were due to pressure on the cord, and whose continuance was an exceeding danger to life, with the fortunate result of bringing about recovery, or at any rate of delaying the fatal end.

Sprains and Wrenches compose by far the largest proportion of the injuries to which the spine is exposed; and giving rise, as they often do, to severe and extensive pain, as a prominent symptom, they are liable to cause much hesitation and difficulty in diagnosis, and thereby lead to treatment unsuitable perhaps for their relief and cure. The cervical and cervico-dorsal regions, where movement is free and extensive, and in not much less degree the lumbo-dorsal region of the column, provide the most numerous instances of simple sprain, although no part of the spine can be said to be exempt therefrom, and now and then cases are met with where the whole vertebral column has been subjected to a severe wrench. Amongst the many causes of this injury, the commonest perhaps are the lifting of heavy weights, or the sudden and inordinate bending of the spine from indirect violence, whereby some fibres of muscle or ligament are stretched or strained, or it may be ruptured, either in voluntary efforts to straighten the column, or when unconsciously it is being held rigid and secure against the violence to which it is being subjected. Be the precise cause, however, what it may, the patient feels that he has ricked or twisted some part of his spine, and the local symptoms are usually such as are met with after a like injury in the neighbourhood of any mobile part or joint, and consist in local pain and local tenderness, stiffness and rigidity, and inability to move without suffering, and in the severer cases some undoubted swelling, either from extravasated blood or simple serous effusion.

It must be remembered, however, that such are the smallness and depth of many of the muscles and ligaments, that visible signs of injury are often absent, and we have to rely on the symptoms alone, their mode of onset, and the history of the injury. The local pain may come on almost immediately after the accident, and it is often extremely severe—a common experience after injury of muscular and ligamentous fibres; and this severity of the pain it is which too often leads to an erroneous belief in the existence of injury of deeper and more important structures. And when to this are added unwonted rigidity of the spine and inability to move without much pain, then the suspicion seems strengthened that the spinal cord or its coverings have not escaped injury. The suspicion is too likely to grow into belief, which, unfortunately, may lead to unsuitable or even harmful treatment, if the severity of pain on movement is such that the patient feels the greatest dread in moving at all, or if his attitude be so constrained and his gait so hindered that he presents a condition of pseudo-paralysis. Or again, in cases of severe lumbar sprain, the muscles and ligaments may have been so placed *hors de combat* as to lead to great difficulty in micturition and defecation, results which are by no means uncommon in lumbago, whether due to cold or injury, and which indicate how largely the ease and perfection of these acts depend upon the functional integrity of the muscles which support the spine. The combination of symptoms may suggest very grave inferences, though happily experience tells us that in the great majority of cases they indicate nothing more serious than muscular or ligamentous strain—an injury painful enough in itself, but rarely warranting a dread of future mischief, which may add to the patient's anxiety and thus retard his convalescence.

Far better, however, to draw an unwarranted inference from the symptoms than to fail to recognise the presence of injury to more important parts, for it cannot be forgotten that some of the ligamentous structures of the column are in close proximity to the spinal canal and the blood-vessels within it. Laceration of the posterior common ligament, for instance, cannot occur without risk of injury to the spinal membranes—not immediately, perhaps, by implication of them in the same lesion, but by extension of inflammation from the injured part, if sufficient rest has not been allowed for perfect recovery. So also the ligamenta subflava are in direct relation with the meningo-rachidian veins, and severe laceration of the one may be associated with rupture of the other. Hæmorrhage may thus arise within the spinal canal, not of itself perhaps sufficient to cause appreciable symptoms, but yet enough to be the starting-point of inflammation about the membranes and, it may be, of ultimate degeneration of the spinal cord. Herein lies the danger of any form of accident whereby the spinal column has been inordinately bent, that some one or more of the structures which are contiguous to internal parts may have been hurt, and there are no special signs or symptoms at hand to show that such has been the case.

Perfect rest is at first essential, not only to permit subsidence of swelling, whether superficial or deep, visible or out of sight, and to allow of repair of the injured muscular or ligamentous fibres, but also, and of even more importance, to avoid the risks of inflammation which want of quiet may engender in and about the injured parts. The length of time during which absolute rest is necessary must depend upon the extent of the injury and the mode of the accident, but better too much rest at first than too little. As the pain on movement lessens, so we have an indication that movement is less undesirable than before. The continued application of warmth is most comforting to the patient, and nothing is so beneficial perhaps as a large linseed poultice in which he may lie. For internal medicinal treatment there is usually no call, unless the patient be the subject of rheumatism or 'rheumatic gout,' when, as is well recognised, any muscular or ligamentous pain is likely to be severe and troublesome, and therefore, it may be, to demand the administration of alkalis, of iodide of potassium, of salicylate of soda, or quinine. Constipation must be relieved by occasional aperients, or better by simple enemata, and difficulty in micturition had better be met by the careful use of a soft catheter.

Sufficient rest having been given, the later treatment must consist, as in the case of the larger joints, in movement rather than in fixation and enforced rigidity of the affected part. This is frequently one of the surgeon's chief difficulties, for the pain on movement may be so considerable, and so prone to return for some time after it seemed to have disappeared, that the patient can hardly believe that movement, which at first may aggravate his pain, should be the proper treatment to remove both pain and stiffness. Movement and the application of heat may be combined, while the patient is still in bed, by the old remedy of ironing the back with a hot iron, a means of treatment very often beneficial from the heat compelling the patient to shrink and move, and thus calling into action fibres over which he might not otherwise be able to exert the influence of his will. The relief is often striking; as we see after the manipulation of a joint stiff from sprain, the passive movement soon becomes active, and with the disappearing stiffness the local pain and tenderness considerably subside. It is in these cases that great benefit may be derived from systematic exercises on the Zander method; and the daily application of the continuous or interrupted current to the affected parts, or, better, of both combined, may sometimes give relief when other means have failed. It is essential that the current be strong, and that it be brought to bear on a considerable extent of surface by the use of large flat plates.

In cases of severe contusion or sprain of the dorsi-lumbar spine we sometimes meet with hæmaturia, the result of structural injury to the kidney. By itself the symptom is not serious, unless the amount of bleeding be very large, and even then it is amenable to treatment by the administration of ergot or gallic acid, with perfect rest. The bleeding usually subsides in course of time, as the breach in the kidney becomes repaired, and there is no evidence to show that such an injury is liable to give origin to a chronic nephritis. Lacerations of the kidney by themselves are not commonly fatal, and it is rare to have an opportunity of post-mortem examination, unless there be some other serious lesion which complicates the case.

Spinal Injuries of Railway Collisions.—What has been absurdly termed the 'railway spine' is an affection of the spinal column essentially similar in all its characteristics to the injuries already described. It is a common experience after railway collisions to meet with many cases where there is complaint of pain either about the spinal column itself or in the muscular structures on either side of it; and the combination of symptoms is precisely such as we meet with after other and less special forms of accident. The only difference—if, indeed, difference it be—consists in the fact that many diverse parts of the spine may be affected at the same time. Cervical, dorsal, lumbar, and sacral regions may each and all be simultaneously wrenched or sprained, and as a consequence there may be very severe suffering throughout the whole spine and its neighbourhood, causing much alarm as to the extent of the injury, and inducing a belief that some serious lesion has been inflicted on central structures. The mode of accident is precisely such as would be expected to give rise to spinal wrench or sprain, for the victim of a collision is thrown backwards and forwards in the carriage, and during this violence—against which he is well-nigh powerless—the muscles and ligaments of the spine, as of other parts, are 'set,' or unconsciously contracted, in order to render the spinal column rigid; and thus it happens that the brunt of the violence falls on those structures whose office it then is to prevent undue bending of the spinal column and damage to the important organ within. The result is spinal wrench or sprain, giving rise to acute pain on movement, to local tenderness, to great stiffness, to difficulty in micturition and defecation, and to that sense of weakness in the legs which is common in lumbago, and which is due to the muscular and ligamentous structures of the spine having been rendered functionally inert. And, in the very severest degrees of this form of injury, it seems probable that there is sometimes strain or stretching of the nerve-trunks as they pass outwards through the spine, as evidenced by tingling or pain in their peripheral distributions.

The pain may come on almost instantly after the accident, or it may be delayed for some hours or days, until, by some particular movement, those fibres which have been injured are called into action and their damage is thereby revealed. The cases may vary in every degree of severity, from slight pain lasting only for a few days, to pain and tenderness and stiffness abiding for many months, and causing long-continued incapacity. Unfortunately the sufferers from this form of accident have to contend against influences which may very seriously retard their progress towards recovery. In the first place, it is unusual to find that a spinal sprain is the sole injury received. The circumstances of many collisions are enough to produce a very profound effect upon the whole nervous system, and symptoms may in consequence be developed indicative of very considerable functional disturbance of both cerebral and spinal centres. A condition of nerve-exhaustion or neurasthenia is induced as the result of severe shock—in the judgment of the writer, of shock from fright—which manifests itself in various ways, and complicates the vertebral sprains which otherwise would seem of less importance, and be no less amenable to treatment than sprains inflicted in other accidents. There arise derangements of the circulatory and vaso-motor systems, as shown by palpitation, alternate sensations of heat and cold, sweating, diarrhœa, menorrhagia, and polyuria; sleeplessness, restlessness, nervousness, loss of memory or inability to sustain attention, asthenopia, loss of control over the emotions, early fatigue, whether from physical or mental efforts—symptoms all indicative of some change wrought on the nervous centres, cerebral, spinal, and sympathetic, whereby they are rendered functionally incapable of the same work or control over other organs as before.

Very variable, also, in degree and in duration, may such symptoms be. The exhaustion may be slight and temporary, or may be so profound as to place life in peril, and cases are not unknown where death has occurred from simple nervous exhaustion, without any discoverable pathological changes. The effect is, doubtless, to a large extent, dependent on the nervous temperament of the individual, and experience shows that those in any way predisposed to nervous disorders, who inherit a nervous diathesis, or in whose families nerve-disease is common, are especially prone to suffer from such symptoms after railway collision. Recovery, however, is the usual rule, with appropriate treatment and after adequate time, every effort being made to secure perfect rest of body and mind, and the avoidance of everything conducive to mental worry and anxiety. And this other circumstance may have a potent influence in delaying convalescence—that the sufferer receives compensation in money for the injury sustained. It is unnecessary to enter at length into this matter here; suffice it that the hope of compensation is abundantly proved by experience to interfere very seriously with recovery. While in some cases it acts, doubtless, as a temptation to gross exaggeration and imposture, especially where the injury has been slight; in other and more numerous instances it merely acts as a hindrance to recovery, by preventing the requisite voluntary effort being made to throw off the invalid state. For the sufferer knows that, as long as compensation is to be had for his incapacity, there is no occasion for him to do the best he can to earn his own living by resuming his daily work.

In not a few instances, also, there is a nervous, but really honest, dread lest some mistake be made in the settlement of a rightful claim, quite apart from the worry that is necessarily incidental to legal proceedings. And thus the want of occupation, the invalid life of comparative comfort at another's expense, the uncertainty and unsettlement of mind when a man is waiting to see how his case may turn out, make him alive to every morbid sensation that may arise, and foster a state of chronic invalidism which is the result of his present mode of life rather than of any injuries received. On the one hand, the want of movement and exercise perpetuates the pain and rigidity of his spine; and the general circumstances of his state, upon the other, tend largely to keep up those symptoms which are cerebral rather than spinal, and the best hope of recovery from which depends, most surely, on the return to a natural mode of life. Hence the phenomenon is not uncommon of the very rapid recovery of patients after compensation has been received, not because they have been wanting in *bona fides*, but simply because the chief obstacle to recovery has been removed.

The line of treatment to be followed in spinal wrenches and sprains has been already indicated, and for the general condition of neurasthenia we must be guided by the grand principle to secure adequate rest for the organs which have been disturbed, and especially for the brain. On all persons who have been shaken in a railway collision the advisability of complete abstinence from bodily and mental fatigue, for a time proportionate to the injuries received, should be enjoined. Here, a few days may suffice to bring about perfect recovery; there, a much longer period may be necessary; but of this there can be no question, that any endeavour to walk off the effects of the accident, or to work in spite of the brain-exhaustion so early felt, will only prolong the illness, and may bring forth symptoms which otherwise would never have appeared. No medicinal treatment is of any special avail. Rest must be secured at night by one of the narcotics, if need be, in ordinary use; and the writer would say a word in favour of opium, too much neglected nowadays in the treatment of the sleeplessness and exhaustion which are so often seen together. A note of warning cannot be withheld against the frequent administration of bromide of potassium in these cases of neurasthenia. An admirable remedy for securing sleep at night, either alone or combined with chloral or cannabis indica, it is wholly unsuitable as a sedative to compose 'the nerves,' whose agitation is rather an evidence of exhaustion and loss of control than of superabundant energy from central irritation. Given in large and repeated doses throughout the day, bromide of potassium is fraught with the gravest evil, for it merely acts as a powerful depressant, and keeps up the very condition of nervous exhaustion which we are anxious to remove. Cases, not a few in number, have come under the observation of the writer, where to the symptoms of neurasthenia from railway shock have been added those of bromism from poisoning with this drug, and where improvement has begun the moment it has been withdrawn.

INTRASPINAL HÆMORRHAGE. — Some of the spinal ligaments are closely contiguous to vessels in the spinal canal, and, as a consequence of the severest degrees of bend or sprain, we may have laceration, not only of muscular and ligamentous fibres external to the spinal canal, but of vessels also which lie within it. Hæmorrhage may thus arise, and blood be poured out within the spinal canal, and, if sufficient in quantity, may give rise to definite symptoms. These, however, are rarely the symptoms of loss of blood, but are rather due to the pressure of the effused blood upon the cord itself, or on the nerves coming off from it. Impaired innervation of the parts below the seat of lesion is found, amounting either to total paraplegia, or to some less serious impairment of motion and sensation. The difficulty of diagnosis in these cases is often extreme, for the surgeon has to decide between the existence of grave cord-lesion, and simple pressure on the cord from extravasated fluid.

The history of the accident, and the progress of the symptoms, often provide the only clue; and as, after injuries to the head, gradually deepening coma is often the chief symptom of hæmorrhage within the skull, so the early advent of a paralysis which steadily increases until complete, or almost complete, paraplegia has been reached, after some accident likely to cause severe spinal wrench or sprain, may help to exclude the existence of any graver injury than hæmorrhage. And this sequence is of especial value where the symptoms have not followed instantaneously upon the accident, as is the usual result of simultaneous crush of the cord in fracture-dislocations. The blood may be poured out between the dura mater and the bone, or within the sheath of the dura mater itself, but the symptoms give no evidence of the exact site of the blood, and depend wholly upon the quantity effused.

Treatment must be directed to lessen the hæmorrhage, and so to limit the possible damage to nervous structures, for any continued pressure upon the cord must not only interfere with its functional utility, but may also lead to pathological changes in the cord itself. Absolute rest, the application of ice to the spine while the patient lies upon his face, and the administration of ergot, are possibly the best means for staying the bleeding, though, unhappily, its tendency is to increase, on account of the laxity of the tissues into which the blood is poured. The gravity of the symptoms is due, not to the amount of blood alone, but to the position of the hæmorrhage; for, as in dislocations and fractures, the higher the seat of the lesion, the less chance is there of recovery, or even of prolongation of life. Cases have not been few, however, amongst the comparatively rare instances of this injury, where the hæmorrhage has been low down in the spinal canal, and where there is every reason to believe that the blood has been absorbed, and recovery has been complete.

Short of this result, however, there is the possibility of some permanent damage by pressure on the cord or nerve-roots, some abiding impairment of motion or sensation in the parts below the seat of lesion; while the tendency of secondary degeneration to spread in the direction of certain ‘centres’ in the cord, may make a small and otherwise unimportant hæmorrhage the starting-point of wide-spread disease. Treatment in such cases must be persevering and continuous. Perchloride of mercury and iodide of potassium, or ergot, with counter-irritation by blisters to the spine, may lead to the absorption of the remaining blood, or of any inflammatory lymph which may have been effused around it; while the systematic exercise of the limbs in those movements which have been impaired or lost, with the aid of electrical treatment properly applied by competent hands, may do much to reopen those nervous channels which have been blocked at the seat of lesion.

Laceration of Membranes and Traumatic Meningitis.—This is happily a rare occurrence as the result of simple sprain of the spinal column. The acute form is most commonly induced by gunshot or other injury, which lays open the theca vertebralis, and seriously damages other parts as well. Inflammation starts at the seat of wound, and thence spreads rapidly upwards and downwards until the whole cord perhaps is bathed in pus. The same course of events has been known to follow some less serious lesion of the spine, either, it may be, from septic contamination, or from previous ill-health of the patient. The rapidity with which inflammation spreads is sometimes terrible, and amply justifies the term ‘foudroyant’ which has been applied to this form of meningitis. Ushered in with rigors or shivering, the temperature soon runs high; tenderness and pain are more or less marked throughout the spine, with dread of being touched or moved, and irritation of the roots of the nerves gives rise to extreme restlessness, to muscular spasm, and widespread cutaneous hyperæsthesia or tenderness. Opisthotonos, too, may occur, either from irritation of the posterior cervical and dorsal roots, or as an instinctive means of relaxing the muscles in order to relieve pain. Vomiting and delirium may also be prominent, and the patient rapidly wastes. Death occurs early, and we find *post mortem* a layer of lymph, in which the amount of pus may vary, on the inner surface of the dura mater, while the meshes of the pia mater are distended with seropurulent exudation. As to treatment, it is impossible to speak with any degree of hope. Ice should be continuously applied to the spine, and it may be well to try the effect of repeated small doses of calomel, so as to bring the patient rapidly under the influence of mercury. Ergot, belladonna, and aconite have also been recommended, but it is very questionable whether any medicinal influence can be brought to bear on the cause of the inflammation.

Not less important than cases of acute traumatic meningitis are those where the meningeal inflammation is sub-acute or chronic, and where the absence of any definite symptoms of inflammation *per se* leads very often to the greatest difficulty in diagnosis. The development, however, of a low form of inflammation which leads to thickening and induration of the spinal membranes, and their adhesion together or to adjoining parts, is one of the results to be feared after any and every severe wrench of the spine—a kind of accident which may be calamitous in the future because we are at a loss to know whether the injury has really been of such a nature as to lead to meningitis, or to tell how and when it may begin. It can only be conjectured that it arises as an extension inwards of inflammation from some point of injury or irritation in some part of the spinal column external to, or immediately adjoining, the spinal canal. Pain and local tenderness and spinal stiffness are such ordinary evidences of simple and even slight sprain, and are so often absent even when pachymeningitis exists, that alone they are untrustworthy signs of subacute intra-rachidian inflammation, and unless there be some distinctive symptom of nerve-disorder a diagnosis can only be most uncertain. Pain or hyperæsthesia in the region of special nerve-distributions, alterations in the reflexes, departures from the normal reaction to electricity of different muscles, anæsthesia in various degrees, impaired motor power, atrophy or rigidity of individual muscles or of groups of muscles with the same nerve-supply, are therefore of much greater value as symptoms of some meningeal thickening than are spinal tenderness, stiffness, and pain.

It is in these cases that from very small beginnings much havoc may be wrought by secondary degeneration of the nervous centres, and it is therefore all the more incumbent on the surgeon to pass by no symptoms suggestive of meningeal inflammation in the very earliest moments of the disease. And in chronic meningitis, with its various consequences, as has been seen already in acute, one has, unfortunately, too often to recognise the futility of treatment, and the only hope may lie in the possibility of a syphilitic taint being at the root of the mischief. The long and persistent administration of iodide of potassium and mercury, separately or combined, may help here, as in other late manifestations of acquired syphilis, while in the absence of that taint they may possibly tend to the absorption of simple inflammatory products. Nor should we fail to make use of counter-irritation, in the shape of blisters to the spine—a mode of treatment once in common vogue for spinal diseases, but now, perhaps, too much neglected or despised.

Fractures and Dislocations of the Spine.—Simple dislocation without fracture is not so uncommon as it was at one time thought to be, and it is in such cases, rather than in cases of fracture or fracture-dislocation, that recovery is most likely to ensue. And the reason thereof is that in simple dislocation the spinal cord is much less liable to severe injury, that its structure is less likely to be disorganised by the crushing into it of sharp fragments of bone, and that there is a better chance of being able to remove the simple pressure which the displaced vertebræ are exercising upon it. Thus accurate diagnosis is, if possible, of supreme moment. That a grave injury has been inflicted on the cord can be told at once with only too much certainty, for on that point the immediate paraplegia leaves no doubt; but we have to discover how and where the lesion has been caused. The point where can be learned by application of our knowledge of nerve-distribution, and by deciding the line—often a hyperæsthetic line—where palsy begins; but the manner how, whether by instant crush from displaced bones, by the simple pressure of extravasated blood, by severe bend and therefore disorganisation of the cord, or by simple concussion of the cord, is frequently a matter of the greatest uncertainty. We have to fall back upon a history of the accident, and upon careful examination of the spine itself, to feel or see whether there be any projection or displacement obviously discoverable by physical signs.

The presence of a projection, and therefore of displacement, should at once raise the question whether steps should not forthwith be taken to reduce it, so that the surgeon may remove the pressure from the cord, and give the best chances of recovery. If the cord itself be undamaged, and the paraplegic symptoms be simply due to the pressure of displaced bone upon it, then—as the record of several cases has proved abundantly—the symptoms may at once subside, and recovery may in the end ensue, when time has been given for repair of the spinal injury. And even when there is something worse than simple pressure, and the cord is being lacerated by some sharp fragment of bone, the reduction of displacement may perchance release the cord, and thereby lessen the risks of inflammation and add to the chances of life. Help in diagnosis may be obtained from knowing the site of the injury; for of the three regions, cervical, dorsal, and lumbar, pure dislocations are found most often in the first, and as we go lower down dislocations become rarer and fractures more common, though commonest of all are the two combined. In whatever region dislocations occur the intervertebral substance is more or less torn and lacerated, and, as a rule, the vertebra which is upper at the seat of separation, carrying with it all the vertebræ above it, is dislocated forwards on that which is below, as, for example, the fifth cervical upon the sixth; and *post mortem* we never find a vertebra separated from both its neighbours. One or both of the articular processes are usually at the same time dislocated, while there is an almost infinite variety in both the character and degree of the injuries to ligamentous structures.

Everything, doubtless, depends on the mode and severity of the accident, whether the separation be great or little, whether it be, or be not, associated with fracture, and whether the cord be much or little damaged. Here, again, there is infinite variety. In the cervical region, for example, there may run, in connection with the dislocation, a line of fracture through the spinous processes or the laminæ of the displaced vertebra and its neighbours. There may also be fracture through one or more of the bodies, but whatever the precise lesion, whether in this region or in others, it sometimes happens that by its own natural resilience, and by that of its various ligaments, the displacement is only momentary, and the spine at once springs back into its natural position. But in that moment the damage to the cord was done. Lower than the cervical region pure dislocations are extremely rare, for, in consequence of the anatomical formation of the dorsal and lumbar vertebræ, a much greater force is necessary to produce separation, and fracture with dislocation is almost invariably found. The line of fracture may run through almost any point of the vertebral arches; there may be endless variety in the extent of the displacement of parts so detached, and very commonly there is fracture through a vertebral body also. The chances of successful reduction of displacement in the lower parts of the column are, unhappily, small, for it is well-nigh impossible to use sufficient force in the right direction, and it is questionable whether in any but a small minority of cases good will result from prolonged attempts to replace the parts in their proper relative positions. Post-mortem examination proves only too clearly that the displacement is often permanent and irreducible, and that the spinal cord has been irreparably damaged. It is found soft, pulpy, and diffluent at the seat of injury, either because it has been crushed by the displaced bones, or because its structure gave way in the excessive bend to which it was subjected. For these injuries, in whatever region, are most commonly caused by some severe and sudden bend of the spine, usually from indirect violence, in such a manner that the spine is bent upon itself, the weight of the parts above and below the site of bend adding momentum to the original violence.

Cases are not few where a wholly unsuspected fracture—'latent' fracture, as it has been termed—has been found after death, while both the nature of the accident and the symptoms afterwards had led to the belief that none was present. Settled pain in the region of one or two vertebræ, increased by manipulation of the spinous processes, and a sense of weakness or want of support at one point of the back, may be the only symptoms present—symptoms wholly subjective, but nevertheless deserving of great regard in face of the risk of secondary implication of central structures. Extravasation of blood within the theca vertebralis, meningitis, myelitis, suppuration,—these are the dangers to be feared, and we name them, not because they are common results of simple fracture without immediate injury to parts within the canal; but rather as a warning, and forcibly to urge the need of taking all conceivable care until time has been given for reunion of the fracture.

DISLOCATIONS OF CERTAIN VERTEBRÆ.—Dislocation of the *occiput from the atlas* is so rare that it may be left out of account in treating of spinal injuries, but dislocation of the *atlas from the axis* is by no means uncommon, as the result of falls upon the neck or head, or of any sudden strain upon the uppermost part of the spine, such as must be caused in execution by hanging. Death is usually instantaneous from crush of a vital part of the cord, for the rupture, which is almost invariable, of ligamentous structures—of the transverse ligament usually, of one or both check ligaments according to the nature and violence of the accident—allows the cord to be pressed forwards from behind and squeezed against the odontoid process. A like result may ensue from sudden and violent rotation of the head, whereby one of the check ligaments is torn, and laceration of others immediately follows. Instant death is the usual rule, but even in this region, bearing within it structures essential to life, there are exceptions.

Dislocations, uncomplicated with some fracture, are almost unknown between *the axis and the third vertebra*, separations between the first and second being the usual injury in this part of the neck. The cases, however, are numerous in which there has been fracture, with or without displacement, of the upper vertebræ, both from direct and indirect violence, and not a few where union has taken place and death been due to some other cause. It is in the lower part of the neck—below the third vertebra, that is—where dislocations most commonly occur, giving rise, in addition to the symptoms of cord-injury, to local pain, undue mobility, deformity, irregularity or gaping of the spinous processes, and, in some instances, well-marked projection in the pharynx, with, it may be, difficulty in swallowing. Reduction should be attempted, if need be under the influence of an anæsthetic, as soon as possible, warning having been given beforehand, both to the patient and his friends, that the procedure of reduction is not without its own immediate dangers.

Unilateral dislocations may occur in the cervical spine; separation of an inferior articular process from the superior of the vertebra next below it being sometimes caused by sudden and extreme rotation of the neck, or even by turning the head too sharply to one side. The diagnosis is comparatively easy; the face is turned and fixed towards the side opposite to the injury, there is obvious deformity and local pain, and more or less of paralysis. Reduction must be undertaken at once, by forcible traction on the head, so as to disengage the processes, and then turning the head and upper spine into their proper axis. Counter-extension may be obtained by placing the knees against the patient's shoulders, and success is often indicated in the reduction of this dislocation, as of others which are bilateral, by an audible snap. The prognosis is favourable or the reverse according to the amount of palsy—of probable damage, that is, to central structures—and to the presence or absence of fracture. The after-treatment should obviously be directed to securing perfect rest and immobility for several weeks after the accident—a matter of no small difficulty, it may be, in bilateral dislocations when continuous extension may have to be maintained in order to prevent a return of the dislocation.

Paraplegia, or paralysis of motion and sensation—of motion, usually, more complete than of sensation—of all parts below the seat of injury, enables us to fix the level of the spinal injury and of the cord lesion; in the estimation of which it must be borne in mind that the cord is usually crushed at, or a little below, the level of the lower border of the displaced vertebra, and that the nerves issue from the spinal canal at a lower level than their origin from the cord. Their obliquity within the canal gradually increases from above downwards, and the nerve-supply is thus interrupted lower than the number of the displaced vertebra implies; while conversely, when we are endeavouring to decide the site of spinal injury by noting which nerves are completely paralysed, the fracture is really higher up than the level at which such nerves come out of the spine. Prognosis depends materially upon an accurate knowledge of the site of the lesion. The higher we ascend in the column, the greater is the danger to life, for the nearer are we to the respiratory centres, whose early involvement in inflammation is surely fatal. The cervical nerves, the eighth alone excepted, are named, it must be remembered, from the vertebra above which they come out, and the fourth cervical nerve, which chiefly supplies the diaphragm, issues above the fourth cervical vertebra, and upon the implication of its centres virtually depend the chances of recovery, and the length of life. Cases are on record, however, in which life has been prolonged even after severe damage to the cord above the origin of the phrenics—a circumstance due, in all probability, to the fact that the cord had not been injured in its entire thickness.

The chances of life are naturally much lessened when diaphragmatic breathing alone remains, the thoracic muscles of respiration being paralysed. The diagnosis of this form of breathing is free from much difficulty, its departure from the normal being most striking and characteristic. The thoracic walls do not remain motionless, as might be expected from palsy of the muscles which move them; but, by the influence of atmospheric pressure, they move at the wrong time, sinking when the diaphragm descends, and rising somewhat suddenly when the diaphragm becomes flaccid. Thus the enlargement of the chest-cavity, from contraction of the diaphragm, is counteracted by sinking in of the chest-walls just at the very moment when they ought to be expanding, and extra work is thus thrown upon the diaphragm. Respiration therefore becomes gradually more and more embarrassed, although sometimes it is marvellous how long life may continue with diaphragmatic breathing alone. The lower the seat of injury, the less likelihood is there of the cord having been entirely destroyed, and the cases are not few in which after fracture-dislocation in the lower dorsal and lumbar regions, there has been recovery sufficient to allow of very fair enjoyment of life. In such cases it is most important to re-educate the paralysed muscles, so soon as time has been allowed for consolidation of the fracture; for if any healthy structure remains, the functional restoration of the cord may be materially advanced both by exercise of the will upon the paralysed muscles, and by the proper and persevering use of electricity, by galvanisation of the cord and of the nerves and muscles below the seat of lesion, to call them into activity and reopen the obstructed paths in the medulla. It is a great mistake to rest satisfied with life having been spared, and not to make most strenuous efforts at an early date to bring about some restoration, be it only partial, of the functions of the cord.

Paralysis of the bladder, as a usual rule, is complete, owing to the fact that both sets of muscles which govern the act of micturition are paralysed. But we may have palsy of the one without the other, and the separate and seemingly contradictory phenomena of retention and incontinence. The sphincter vesicæ and the detrusor urinæ have, in all probability, distinct and antagonistic centres in the cord. The healthy act of micturition consists in reflex excitation and action of the detrusor with, at the same time, inhibition of the centres of the sphincter, which thereupon relaxes; and although these centres usually act automatically on the requisite stimulus, they are under voluntary control during the integrity of the spinal cord. If this integrity be destroyed by lesion above these local centres, paralysis will be complete or incomplete according to the amount of interference with the spinal centres themselves. Let the centres *per se* be unaffected, and the cord destroyed higher up, all voluntary control is cut off, and micturition may occur in a seemingly natural way from time to time as the bladder fills, without the knowledge of the patient. On the other hand, the character of the act may vary according to the affection of the local centres themselves. Opinions have differed as to the advisability of using the catheter in these cases, some surgeons deeming it unnecessary, others fearing that cystitis may be caused thereby. There need, however, be no difficulty in avoiding the introduction of septic or unclean matter into the bladder by the use of an instrument which is perfectly clean, for which purpose it is well to keep the catheter continuously in carbolised water; and there can be no question as to the desirability of preventing the patient, or his bed-clothes, from being perpetually soaked in urine. On the whole it seems better to use a soft catheter morning and evening, or oftener if need be, to ensure the complete evacuation of the bladder, to avoid the smell of incessant urinary flow, and to keep the patient dry. But, above all things, let care be taken that the catheter is absolutely clean, and that it be passed with all tenderness.

The act of defæcation, like that of micturition, is a complicated one, for although under voluntary control, it is also under the immediate influence of spinal centres, of which one is for the muscles of expulsion, the other for the sphincter to close the orifice. Contraction of the one set of muscles, and relaxation of the other ordinarily go together; but if voluntary control be withdrawn, defæcation may occur unknown to the patient, whenever his rectum is sufficiently loaded to excite the reflex act of expulsion, the sphincter being at the same time paralysed. The rectum, however, is not so continuously filled as the bladder, and there is no constant discharge of fæces, as there is of urine when the sphincter vesicæ is paralysed. Be the precise nervous mechanism what it may, the difficulty and duty arise of endeavouring to keep the patient clean and dry. Occasionally, however, we meet with the opposite trouble of constipation from the normal peristalsis of the intestines being annihilated, and to this may be added alarming tympanites from palsy of the intestine.

Interference with the normal action of yet other supposed centres in the cord gives rise to a symptom very often met with in cases of fracture-dislocation, i.e. priapism—a vascular turgescence, or quasi-erection, of the penis, which is most frequently seen after injuries high up, but which may be present when the lesion is quite low down, even in the lower dorsal or lumbar region. This used to be regarded as a symptom of grave import, but probably without due warranty, for there is no evidence to show that, by itself, it is a more certain evidence than others are of grave and fatal injury to the cord. The precise manner in which priapism is caused is not known. By some it is thought to be a merely passive condition, due to vaso-motor palsy, which permits filling and distension of the vessels of the erectile tissue; while others look upon it as due to irritation of supposed sexual centres in the lumbar portion of the cord.

Few questions in connection with these injuries of the spine and spinal cord are of greater interest than the variations of temperature observed in different cases. It seems impossible to predict of any injury that it will be followed by a high temperature or by a low one, and little more has yet been done in elucidation of the differences than the careful observation of unusual examples of one condition or the other. Excessively high temperatures of the paralysed parts have been most often met with in injuries of the cervical cord; but yet very low temperatures have been noted in apparently similar cases, while in some an early high temperature has been followed by an abnormally low one until the time of death. As far as can be told, there is no special lesion to account for these differences. It has been observed, however, that in cases of high temperature the pulse is usually full and bounding, while in the opposite the pulse is small and feeble, and to Mr. Hutchinson we owe the suggestion that the character of the circulation really determines the degree of temperature. Parts paralysed naturally develop less heat, and when nearly the whole body becomes a cooling area, as after cervical injuries, the bodily temperature will be low unless the strength of the circulation be such that the free supply of blood to the paralysed area not only prevents a fall in temperature, but even creates a balance on the other side. Notwithstanding thermometrical observations, the whole question of temperature variations is still very obscure.

Bedsores and changes in the urinary excretion demand the attention of the surgeon; for, though not adding materially to the patient's suffering, they have their own special dangers. *See* BEDSORES; BLADDER, Diseases of the.

CONCUSSION OF THE SPINAL CORD.—The question whether there is such a thing as true 'concussion of the spinal cord' need not long detain us. That the brain may be structurally injured by pure concussion is of course an accepted fact within the experience of all, but it is a wholly different matter with reference to lesion of the spinal cord. Medical literature, it is true, contains not a few cases of traumatic lesions of the cord, which have been attributed to the effects of concussion; but in the judgment of the writer this has been the result of a too ready trust in a supposed analogy between the brain and the spinal cord. It has not been sufficiently recognised that the physical surroundings of these two organs are widely different; and it does not follow in the least that because they are parts of one system they are therefore both liable to the same form of injury. The brain is so lodged in the skull as to be especially prone to suffer structural injury from concussion-blows upon the head; the spinal cord, on the contrary, surrounded by fat and fluid and suspended to the sides of the chamber in which it lies, is placed so as to be securely protected from any evil consequences of similar injuries to the back or spine, and the analogy between brain and spinal cord is in this respect deceptive and unwarranted. Nevertheless there are cases of cord-lesion which can be satisfactorily explained on no other hypothesis than that of concussion; but when we have excluded those cases where the bruising of the cord has been produced by actual crush of displaced vertebræ, by severe and sudden bend of the cord itself, or where the symptoms have been due to the pressure of blood, it is singular how very few remain. And it is well that it should be so, for a new danger would be added to life if an organ of such vast importance in the animal economy as the spinal cord were liable to structural lesion from the same kinds of force as cause concussion-lesion of the brain. A lesion which may be of small size and possibly of small moment in the case of the brain, cannot be otherwise than of great moment, even if only of small size—in the case of an attenuated and slender cord which is the sole medium of communication between distant parts. And happily, as a matter of fact, the spinal cord is very rarely thus injured in the absence of injury to the form and structural integrity of the spinal column.

THE OPERATION OF TREPHINING THE SPINE proposed many years ago, and adopted several times, has made no progress in surgery, nor is it likely to do so. In cases of fracture-dislocation the cord is usually damaged irreparably; and when permanent pressure is exerted on the marrow by displaced bone, exact diagnosis is often impossible, and the physical difficulties of removing or elevating the displaced vertebra —be it remembered the body of a vertebra, and therefore far removed from the surface —would be almost insuperable. And we should add gravely to the dangers of the case by laying open the spinal canal. Here, again, a too ready assumption of analogy between brain and spinal cord led in all probability to this operation, which a clearer understanding of the physical differences in the situation of the two organs would have shown to be little feasible, and less likely to be followed by good results. It is an operation not within the range of practical surgery.

PUNCTURED WOUNDS.—Some of the most formidable injuries with which the surgeon has to contend are punctured wounds in the cervical region. The horizontal direction of the spinous processes in this part of the column renders it comparatively easy to open the spinal canal, to incise the theca vertebralis, or even to wound the cord; but in other regions also the spinal canal may be opened by some sharp instrument, such as the point of a sword, if the force of the blow has been great, and its direction sufficiently oblique. The extent of the injury will be revealed only by the resultant symptoms of nerve-impairment, of more or less paralysis, and possibly also by the escape of cerebro-spinal fluid. While surgically of the gravest moment, these cases are, at the same time, worthy of all study from the light thrown by the symptoms on the physiology of the cord. The danger of meningitis is great, and if the cord has been wounded, there is risk that repair may be imperfect, or that the injury may be the starting-point of secondary degeneration. It is important to cleanse and close the wound, removing any foreign body suspected to be present, and to keep the spine at perfect rest.

Little less serious, because of the difficulty of treatment, are punctured wounds of the large vessels in the posterior part of the neck: the posterior auricular, the arteria princeps cervicis, and the occipital, the vertebral, and profunda cervicis. The record of cases seems to show that ligature of the carotid trunk is usually of little lasting avail for the arrest of hæmorrhage from its branches, owing to the very free cross-anastomoses, while ligature of the first part of the subclavian is likewise impracticable. The surgeon must therefore rely on the less formidable procedure of finding, by careful dissection, the precise vessel which has been wounded, and placing a ligature above and below the bleeding point. This is the line of practice which ought invariably to be followed, if the hæmorrhage is such as to indicate that any large vessel has been wounded. The danger to the patient even of free incision, to find and secure the vessel, is far less than that of repeated hæmorrhages and burrowing of blood throughout the tissues of the neck. After puncture of the vertebral artery, however, it may be no easy matter to put a ligature upon it as it lies within its bony canal, and ordinary pressure upon the surface is likewise of little or no use in arresting the bleeding. It is essential to expose the bleeding point, and here success has attended the practice of careful plugging against the transverse process; and in a recent case the plan was adopted of plugging with antiseptic material which it was possible to leave in the wound long enough to secure complete occlusion of the vessel.

In all these operations it is important to carry out most thorough antiseptic treatment, so as to avoid the risk of spreading suppuration in the deeper parts of the neck. For suppuration itself may lead to opening of some deep vessel, and in a remarkable case, recently under the care of Mr. Banks, of Liverpool, when the patient had nearly perished from loss of blood, that surgeon cleared out a huge mass of putrid blood-clot which filled up the whole posterior part of the neck from mastoid process to clavicle, and applied ligatures with success at the very origin of the occipital artery, just in front of the transverse process of the atlas, where the bleeding point was found. Antiseptic surgery and antiseptic plugging hold out better hope of success than has hitherto often attended the treatment of these very dangerous wounds of the vertebral artery; while the avoidance of after-suppuration goes a long way to render less formidable the requisite operation of free dissection to find the source of hæmorrhage after punctured wounds in the posterior parts of the neck. HERBERT W. PAGE.

BACTERIUM.—An oval or ellipsoidal micro-organism, forming a definite genus in the class of Schizomycetes, viz. the micro-bacteria of Cohn. As a rule the length is never more than twice the breadth. The term bacterium was formerly used to denote the whole class of Schizomycetes, but it is now restricted to those falling under the above definition.

For general characters, see the article SCHIZOMYCETES.

The bacteria reproduce themselves mainly by fission. There has also been described (Dallinger) a fusion of two individuals (*B. termo*) with the resultant formation of a cyst containing spores, which on liberation develop into adult bacteria.

(1) SAPRIC BACTERIA are two, as known at present, and the first is more important, being supposed to be the agent by means of which putrefaction goes on in animal fluids, resulting in the formation of the alkaloidal substance sepsin, the poison of sapræmia.

B. termo. Usually dumb-bell in shape, perhaps from rapid multiplication. Injection into the tissues or blood of animals produces no effect. It is very active, and provided with a flagellum.

B. lineola. Found in ponds, and forms the common bacterium fungus on boiled potatoes. It is larger than *B. termo*.

(2) The PATHOGENIC BACTERIA are very interesting from their excessive virulence.

B. septicæmiæ (Koch & Davaine) is an oval organism, the protoplasm of which is collected at each end, leaving a central clear space. That observed by Koch was found in septicæmia of birds, being obtained from putrid meat, while Davaine's experiments were carried out in rabbits, the organism being derived from putrid ox-blood. The latter organism exists in the blood to such an extent that a billionth of a drop has proved fatal, and even a trillionth (Davaine).

B. of chicken cholera. The organism of this infectious disease is supposed to be a bacterium. VICTOR HORSLEY.

BALANITIS is an inflammation of the mucous membrane covering the glans penis. It may be the result simply of want of cleanliness, and this is especially the case in young subjects with long foreskins. It is, however, more usually an accompaniment of gonorrhœa, and arises from the extension of the inflammation of the urethra to the surface of the glans penis. A further extension of the disease to the mucous layer of the prepuce constitutes what is called balano-posthitis. The symptoms are itching and swelling both of the glans and the prepuce, which latter sometimes becomes œdematous. There is also a profuse discharge of fetid pus. If the prepuce can be drawn back and the glans exposed, the latter will be found swollen, red, and bathed in fetid discharge. Frequently the epithelium becomes eroded, leaving superficially ulcerated surfaces.

Sometimes crops of herpetic vesicles appear, which run together, forming ulcers which might possibly be mistaken for chancres. In fact, it is necessary to remember that a balanitis may be caused by syphilitic chancrous erosion of the glans. The absence of urethral discharge, the defined ulcer, the induration, and, especially the history as to the period of incubation, will all help towards the formation of a correct diagnosis in such a case. The extension of the inflammation to the prepuce is marked by a still further swelling of that part, caused by effusion into the cellular tissue between its two surfaces; the result being complete inability to retract the prepuce, constituting a phimosis.

It is in conditions like this that some difficulty arises in making a right diagnosis as to whether the patient is suffering from gonorrhœa or syphilis. The absence of any history of a sore, the failure to detect any indurated or painful spot beneath the prepuce, the unmixed purulent discharge, the scalding on passing water, and the presence of chordee, are all symptoms leading to the conclusion that the case is one of balanitis arising from the infection of a gonorrhœa. On the other hand, the history of the presence of a sore, and the detection of a painful and indurated spot beneath the prepuce, the admixture of blood with the discharge, the enlargement of the inguinal glands, and the absence of scalding and chordee, would all point to the presence of a chancre beneath the inflamed prepuce. When the prepuce is short and the orifice small, a paraphimosis is occasionally formed by the prepuce slipping back behind the corona, the swollen condition of the glans rendering it impossible to replace it at the moment. The contracted preputial orifice acts as a tight constricting band, causing considerable swelling and œdema of the surrounding parts. The pain is sometimes excruciating, and unless relief is soon afforded, ulceration, or even sloughing, of the parts may take place.

The *treatment* of balanitis varies with the intensity of the disease and the complications which require to be met. When it arises in a young subject, from the collection of secretion beneath a long prepuce, simple attention to cleanliness will go far to effect a cure. The prepuce should be drawn back twice or three times a day, and the parts thoroughly washed with tepid water and dried. They should then be dusted over with a powder consisting of equal parts of starch and boracic acid, and the prepuce replaced. In the event of a recurrence of the disease, circumcision should be performed as soon as the discharge has been arrested. It is well known that amongst the Jewish community the rite of circumcision confers immunity from this disease. When, however, balanitis arises as a consequence of venereal disease, more active measures are needful.

In addition to the ordinary treatment of gonorrhœa, if the inflammation is confined to the glans, it will often suffice simply to cleanse the parts three or four times a day, and keep them dusted over with the starch and boracic acid powder, or the simple insertion of dry lint between the glans and the prepuce, frequently changed, will sometimes effect a cure. If the disease has extended to the prepuce with much swelling of the parts, hot fomentations and an occasional warm hip bath will be found useful. The application of nitrate of silver, either by passing a solid stick underneath the prepuce, round the glans, or else by injecting a solution (gr. 40–f℥j.) is useful, followed by the constant use of a lead and opium lotion, applied externally on lint and injected underneath the prepuce. As soon as the prepuce can be withdrawn, if the surface of the glans is found to be eroded, one of the best applications is the oleate of zinc spread thickly on lint on both sides, and inserted between the glans and the prepuce. If phimosis is established it can seldom be needful to resort to operative measures for its relief during the acute condition. Hot fomentations, soothing injections, rest in bed, and keeping the penis in an elevated position, will be useful.

Should it, however, be needful to expose the glans, the prepuce should be slit up on its dorsal surface, but the completion of the operation should be deferred until a later period. When paraphimosis exists, means should at once be taken to effect its reduction. *See* PARAPHIMOSIS.

PAUL SWAIN.

BANDAGES are usually made of unbleached calico, but in special cases and for special purposes a variety of materials are used, the chief of which are washed calico, linen, flannel, lint, muslin, gauze, elastic webbing, and india-rubber.

Whatever material is used it should be sufficiently firm and strong to effect the object for which the bandage is applied, and at the same time be supple enough to be evenly adapted to the inequalities of the limb. If the bandage is to be applied wet, washed calico should be used; when warmth combined with some amount of elasticity is required, flannel is very useful; whilst, if elasticity is the property mainly desired, elastic webbing or Martin's india-rubber bandages are the best materials; if lightness and open meshes into which plaster of Paris may be rubbed are required, nothing is better than the kind of muslin known as crinoline.

Bandages are classified as 1. *Simple*; 2. *Compound*. A simple bandage consists of a continuous piece of material wound up into a roller, and hence called a *roller* bandage.

A compound bandage is more complex, and requires more than one continuous piece for its formation; the four-tailed, the many-tailed, the T-bandage, and the suspensory bandage, are compound bandages.

The *Roller* bandage is made by tearing the material used into strips, varying in width from three-quarters of an inch to six inches, and in length from two to ten yards, according to the part of the body for which it is required; for the fingers it should be three-quarters of an inch wide, and a yard and a half long; for the upper limb and head from two to two and a half inches wide, and six yards long; for the lower limb two and a half to three inches wide, and six or eight yards long; for the body four to six inches wide, and ten yards long.

No selvage should be included in the bandage, as it would be liable to cause uneven and painful pressure.

Bandages should be tightly and evenly rolled. If a bandage be rolled up from one end only it is called a *single-headed* roller, whilst if from both ends it is called a *double-headed* roller. A roller bandage is said to have two extremities, a head, body, and two surfaces; the free end is called the *initial extremity*, and that in the centre of the roller the *terminal extremity*, whilst the intervening portion is the *body*; so much of the bandage as is at any time rolled up is known as the *head*; the two surfaces are inner and outer.

When applying a bandage, the surgeon should stand in front of the part to be bandaged, and, if a limb, he should take care to place it in the position it is intended to occupy, for a subsequent alteration of it not only disarranges the bandage, but renders it liable to constrict the limb. He should hold the roller in the right hand if the left limbs are to be bandaged, and *vice versâ*, and then, placing the initial extremity on the front of the limb, he should fix it by a circular turn, so placed that the bandage is laid on from the inner to the outer side as it passes over the anterior surface of the limb.

To remove a bandage, the terminal extremity should be taken up by one hand and passed behind the limb to the other, and by this back again in front, the folds of the bandage being gathered together into a bundle as they are transferred from one hand to the other; by a quick succession of these movements the bandage will be rapidly and tidily unwound, and will not be twisted upon itself.

In applying a simple bandage to any part, one or other of the following methods, either alone or in combination, will be used. They are named according to the arrangement of the turns of the bandage.

The *Circular* bandage consists of a number of turns arranged so that each accurately covers the preceding one; it is used to keep dressings on the forehead, the sides or back of the scalp, or the neck, and to retain pads on particular points.

The *Oblique* bandage is applied by allowing the roller to follow its own course smoothly up the limb; the result of this is that parts are left uncovered between the turns of the bandage. It is used to retain dressings, such as fomentations, which require frequent changing, and is of special value in the application of the earlier layers of plaster or other immovable bandages, where a number of layers are used, for in that case all the intervals may be subsequently covered in; and there are the advantages that the bandage lies quite smoothly without reverses, and also that the fibres run more nearly longitudinally and so afford extra strength, and obviate the tendency to transverse cracking, which is so liable to occur when the bandage is applied spirally.

The *Spiral* bandage is, as its name implies, wound spirally round the limb; each circle of the spiral should overlap the preceding one by about one-third of its width; it is only applicable to regions where the size keeps the same or but slightly increases, as the fingers, just above the wrist and ankle, the upper arm, or the chest.

The *Spiral* bandage *with Reverses:* when the spiral bandage is applied to a part whose circumference rapidly increases in size, the roller will, if laid on evenly, soon run upwards obliquely and leave an interval between two successive turns; in such cases it is necessary to bring the bandage down to the proper level by what is called *reversing*, or so turning it on itself that what was before the upper border becomes the lower, and the inner surface the outer. To reverse the bandage the roller should be unwound for two or three inches beyond the place where the reverse is to be made, and the part of the bandage which is already applied should be drawn firmly to the limb, and, in the case of a left limb, the left thumb placed on the lower border of the bandage at the required situation. With the head of the bandage held loosely by the right hand in the supine position, a movement of pronation will fold over the upper border so as to make it the lower one, and then the roller can be carried onwards evenly round the limb, overlapping one-third of the previous turn, until it reaches a point in a line with the previous reverse, where the whole proceeding should be repeated. Before removing the thumb which fixes the lower border of the bandage, the roller should be drawn tight, in order to make the reverse lie smoothly and prevent wrinkling of the bandage. The reverses should be made to fall in one line along the limb, and should be so situated as to avoid bony prominences. This method of bandaging is chiefly used for the forearm and leg, and should not be used for other regions if the simple spiral bandage will do.

The *Figure-of-eight* bandage is another method of bringing the bandage down when it is advancing too rapidly up the limb; but it is more especially adapted to covering joints such as the ankle, knee, wrist, and elbow: it consists of two circles joined together like a figure of eight, one of them being above the joint and the other below, whilst the crossings are made to fall in one line along the front or outer side of the joint. Though chiefly used for joints, it is applicable to all parts of limbs; but it has, in the latter cases, the disadvantage that the lower border of the upper circle does not lie evenly against the limb, and it is only by the gradual ascent of the lower circles that a tidy, even covering is obtained.

The application of the above methods of bandaging to individual parts is hardly called for in a work of this nature, but some of the more useful special bandages will be described.

The *Halter* bandage is useful for retaining dressings on the chin, vertex of the head, and nape of the neck. Place the initial extremity of a single-headed roller, two inches wide, on the vertex of the head, and carry the roller down the side of the face just in front of the ear, beneath the chin and along the opposite side of the face to the vertex, where it will cross the initial extremity at an acute angle. Then direct it obliquely backwards, in front of and below the parietal eminence, to the nape of the neck, and thence horizontally round the front of the chin and onwards to the nape of the neck again, where its direction must be changed so that it passes below and in front of the parietal eminence of the other side to the vertex, where the terminal end may be pinned; or, if required, the whole series of turns may be repeated.

The *Knotted* bandage is used for making pressure on the temporal artery. Put a pad or graduated compress on the bleeding point, and then, standing on the opposite side of the patient, take a double-headed roller and apply the portion of bandage intervening between the two heads over the compress, and carry each roll circularly round the head until they reach the compress again. Then, if it be the left temporal artery that is to be compressed, the roll coming round the front of the head should be taken in the right hand and turned round the lower border of the other one, and carried upwards with its outer surface applied to the scalp, whilst that now in the left hand should be passed downwards beneath the chin with its inner surface applied to the face. Each roll must be carried round the head, and, meeting again at the injured temple, a second 'knot' should be made, and the ends of the bandage directed horizontally to the opposite side of the head and pinned. The first 'knot' should lie over the compress, and the second accurately over the first, so that their full pressure may be gained.

The *Capelline*, or recurrent bandage of the head is useful for making pressure or retaining dressings on the scalp, and a modification of it is used for bandaging stumps. For the scalp a double-headed roller, two inches wide and six yards long, with one head about a third larger than the other, is required. The operator should stand behind the patient with the larger head in his right hand, and the smaller in his left, and the intervening portion should be placed as low down on the forehead as possible, so that any tendency to upward displacement may be prevented by the frontal protuberances. Both heads of the roller are then carried backwards to the nape of the neck, where the smaller one is taken in the right hand, twisted round the lower border of the other, and directed vertically over the scalp to the root of the nose, whilst the larger is continued horizontally round the head to fix the vertical one in front; after which the latter is carried backwards again to the occiput, a little to one side of the first turn and slightly overlapping it, and is fixed by the continuation of the horizontal turn. Similarly, the smaller head of the roller is carried backwards and forwards over the scalp, first on one side of the middle line and then on the other, until the whole of it is covered in. The horizontal portion must always cross the other superficially, so as to fix it, preparatory to its being turned back again. Finally both heads of the roller will be running nearly horizontally. They should be looped together at the occiput and carried forwards to the forehead, where the ends may be tied or pinned together.

For a *Stump* a single-headed roller will suffice. Take a few circular turns round the limb a little above the end of the stump; fix the bandage on the under surface by the fingers of the left hand, and take a longitudinal turn over the face of the stump and fix it on the upper surface by the left thumb. Repeat the longitudinal turns first on one side of the middle line and then on the other, fixing each as before, until the whole stump is covered in; and finish off by a few circular turns so as to fix the longitudinal ones in their proper places.

The *Spica* bandage is named from its fancied resemblance to a spike of barley: it is essentially a figure-of-eight bandage, one loop of which is larger than the other. It is used for the shoulder, thumb, and groin.

For the shoulder a roller bandage, two and a half inches wide and seven yards long, will be required. Protect the folds of the axilla with cotton wool, and fix the bandage by a few circular turns round the upper arm; carry the roller round the back of the chest and the opposite axilla to the front, and onwards till it crosses the commencement of the same turn on the outer side of the arm, and then direct it beneath the axilla to the front again, and a second time carry it over the shoulder and round the chest and axilla as before. The whole series of turns must be repeated till the shoulder is covered; and as they intersect on the outer side of the arm and shoulder, they should overlap one another by about one-third of their width.

When the turns of the bandage are placed successively higher and higher on the shoulder, as above described, the spica is called *ascending*, but if the first turn is made over the shoulder at the root of the neck and succeeding ones lower and lower, it is termed *descending*.

The spica for the groin is used to make pressure over the abdominal and femoral rings as a temporary support to herniæ, and to retain dressings on any part of the inguinal regions. Take a roller three inches wide and seven yards long, and fix the initial extremity by a circular turn round the upper part of the thigh, passing from the inner to the outer side in the usual way, and then carry the roller round the pelvis between the great trochanter and the crest of the ilium on each side, and next obliquely across the lower part of the abdomen to the front of the thigh, where it will cross the commencement of the same turn, and thence direct it round the thigh and forwards between its inner surface and the scrotum. Repeat the figure-of-eight loops round the thigh and pelvis as often as necessary, and make each turn overlap the preceding one on the thigh by about half its width. It is usual to place the first turn over the lower part of the groin, and the subsequent ones successively higher and higher (*ascending spica*), but they may be laid on from above downwards (*descending spica*).

To bandage both groins, commence with a circular turn round the pelvis, and then direct the roller across the lower part of the abdomen to the left thigh; take a loop round this and continue the bandage round the back of the pelvis to the right thigh, and, after encircling that, carry the roller across the lower part of the abdomen and round the entire pelvis to the left thigh. The turns round the thighs are made alternately and pass from the inner to the outer side on the front of the left one, and from the outer to the inner on the right; when the bandage is completed, there will be, in addition to the intersections on the thighs, a third series of them over the middle line of the abdomen.

The spica for the thumb requires no further description than that it consists of figure-of-eight loops, placed alternately round the wrist and the ball of the thumb until the latter is sufficiently covered.

T-bandages, either single or double, have the shape indicated by their name, the former having only one vertical piece, whilst the latter has two, which are attached, at a short distance apart, to the horizontal limb: they are chiefly used for retaining dressings on the perineum and the parts about, but may be used for the scalp, chest, &c. For the perineum the horizontal portion is fixed round the body just above the iliac crests, and the vertical one made to lie over the mid-sacral region. For the female the vertical portion is undivided and is brought forwards between the legs, over the vulva, and fixed to the front of the horizontal segment; for the male it is split along the middle for a sufficient distance to allow of the ends being brought forward on each side of the scrotum. For the scalp the horizontal portion is fixed circularly round the forehead and occiput, and the vertical one carried backwards, from the former point, over the vertex and fixed to the horizontal portion behind. For the chest the horizontal segment of the double bandage is fixed round the body, and a vertical portion brought forwards over each shoulder, and fastened in front.

The Many-tailed bandage, or bandage of Scultetus, is used where it is wished to combine even support with ease of removal; it is most commonly used for the chest and abdomen. A sufficient number of transverse strips of calico or flannel are arranged parallel to and overlapping one another by about one-third of their width, and fixed so by being stitched along the middle to another strip at right angles to them. To apply it, the connecting piece of the bandage should be placed in the middle line behind, and the transverse pieces brought round the body or limb successively and crossed in front. To prevent the bandage slipping when applied to the chest or abdomen, two strips should be attached to the upper end of the connecting piece, and brought over the shoulders like braces and attached in front.

The 4-tailed bandage consists of a piece of calico split from either end to within a few inches from the middle; it is mainly used for the lower jaw, but is also applicable to the knee and the vertex of the head. For the jaw it should be about four inches wide and fourteen long, with a hole or slit made near one edge of the bandage in the middle to receive the chin, and be split to within two inches of the centre. Put the smaller segment over the lip and fix the tails corresponding with it below the occiput; carry the other ones upwards in front of the ears and fasten them on the vertex; the two pairs should be attached to one another along the middle line of the vertex, so as to prevent their slipping. For the vertex, take a broader bandage with tails of equal width, and place the undivided portion on the top of the head; direct the anterior pair of tails backwards and tie them below the occiput, and the posterior ones forward and tie beneath the chin; for the knee, place the undivided portion over the patella, cross the tails of the bandage behind the knee, and tie the lower ones in front of the lower part of the thigh, and the upper ones in front of the tubercle of the tibia.

The triangular bandage, or the Esmarch bandage, is made by cutting a piece of calico, about forty inches square, diagonally into two halves; of the three borders, the longer is called the lower and the others the side borders; of the three angles that opposite the lower border is called the point and the others the ends. Though of much use as a temporary bandage, on account of its wide applicability, it is not much used in civil surgery, and so calls for but little mention here. To make a small sling, i.e. for the hand and wrist, with a triangular bandage fold it lengthwise twice, throw one end over the shoulder of the injured side, and bring the other one round the front of the wrist and over the sound shoulder and knot it to its fellow. To make the larger sling, i.e. for the whole forearm, place the unfolded bandage on the chest with the point of it towards the elbow, and one end thrown over the sound shoulder; next bend the elbow and bring the forearm to the chest against the middle of the bandage, and support it in that position by carrying the other end of the bandage over the shoulder of the injured side and tying it to its fellow. Finally fold the point of the bandage round the elbow and upper arm, and pin it in front. To make the shawl-cap for the scalp, fold the lower border of the bandage and place it on the forehead with the point hanging down to the nape of the neck; next carry the ends round the head, crossing them behind, and tie them together on the forehead, and finally turn up the point and pin it to the body of the bandage above.

The triangular bandage is also used to retain dressings on the breast and on the gluteal region, and as an improvised suspensory bandage. Bilton Pollard.

BARBADOES LEG. *See* Elephantiasis Arabum.

BATTEY'S OPERATION. *See* Oöphorectomy.

BAVARIAN SPLINT. *See* Immovable Bandages.

BEDSORES.—Whenever prolonged and continuous pressure is maintained on a part there is much danger of gangrene occurring; the pressure impedes or completely arrests the circulation, and if continuously maintained for a sufficient time, death of the affected part will occur from that cause alone. But if the pressure be not prolonged to this degree, the tissues and vessels will be so injured that, on the re-establishment of the circulation, inflammation which may terminate in gangrene will occur, and especially will this happen in old and enfeebled persons and those whose constitutional powers are lowered by fever. In addition to simple pressure there are other potent agents in the causation of bedsores, such as the irritation of urine, fæces, the secretion of the skin itself, creases in the bedclothes, crumbs of bread, &c. Many of these causes are liable to come into greater prominence in some cases, such as fractures of the spine, in which the lower part of the body is paralysed and in which the urine and fæces are passed involuntarily.

In certain injuries of the nervous system bedsores appear very rapidly, and that too when the greatest care is taken to prevent injurious pressure and irritation of discharges; these bedsores are described by Charcot as 'acute'; they may appear within a very few days or even hours after the injury. In surgical practice they are mostly met with after spinal injuries, though they may occur after injuries to the brain; in the latter case they are situated on the upper and inner part of the buttock of the paralysed side, whilst in the former they are situated in the mid-sacral region just above and to the inner side of the cerebral one; the spinal bedsore usually begins on the fourth or fifth day. Acute bedsores are considered by Charcot to result from a lesion of trophic nerves, and by others to be due to vaso-motor paralysis; they are, however, of comparatively rare occurrence.

The simple pressure sores are met with in the regions most pressed upon during prolonged confinement to bed, viz. over the sacrum and trochanters, but they may occur over the elbows, scapulæ, and on the heels, &c.; and sores identical in nature and known as 'splint-sores' may be met with over any of the bony prominences, due to the pressure of splints. The skin first inflames, and if the cause persist, vesication follows; the cutis next loses its vitality and an eschar or superficial cutaneous slough succeeds; this is slowly detached from the surrounding healthy skin, leaving a more or less deep excavated ulcer of unhealthy aspect, and sometimes exposing a portion of carious bone or even opening up the spinal canal and giving rise to septic meningitis.

Treatment.—This should be mainly preventive, and in the hands of the nurse; all sources of irritation should be scrupulously avoided; too continuous pressure on any one region should be prevented by changing the position of the patient where this is possible, and where not it should be evenly distributed and moderated by water-beds, ring-pillows, &c. The parts pressed upon should be systematically washed night and morning, and rubbed with some stimulating and astringent lotion such as spirits of wine, or a solution of bichloride of mercury in proof spirit (2 grains to the ounce). In the erythematous stage the part may be painted over with collodion, with one of the lotions mentioned above, or with a solution of nitrate of silver (10 grains to the ounce). When sloughs have formed, their separation may be hastened by poultices or fomentations, and after their detachment, if stimulants seem indicated, equal parts of resin ointment and balsam of Peru may be applied, and when the sore begins to fill up and look healthy it may be treated as a simple ulcer, provided always that pressure be reduced to a minimum.

Bilton Pollard.

BELLOCQ'S SOUND is an instrument devised to assist in the operation of plugging the posterior nares. It consists of a curved canula, shaped like, but of larger size than, a Eustachian catheter. This contains a stilette terminating in a piece of watch-spring, at the extremity of which is an eyelet for carrying a thread. The canula being passed along the floor of the nose, the watch-spring is made to protrude into the mouth by means of the stilette, and the thread can thus be readily caught and employed to draw a piece of whipcord through the nostril, to which a suitable plug is attached.

BISTOURY.—A French term which has been adopted by English surgeons. There are several varieties of bistoury—viz. straight and curved, sharp and probe-pointed. The straight, sharp-pointed bistoury is useful in amputating fingers, the curved in opening abscesses; the probe-pointed instruments are useful in dividing fistulæ and the stricture in hernia.

BITES OF VENOMOUS INSECTS AND REPTILES. *See* STINGS OF INSECTS.

BLADDER, Diseases of the.—ATONY OF THE BLADDER.—*Loss of Contractile Power of the Muscular Coat.*—This affection is induced in various ways; most frequently by moderate obstruction to the outflow of urine, a difficulty not sufficient to cause hypertrophy of the muscular coat. Probably a constant factor, as a predisposing cause, is a tendency to degeneration of the muscular tissue; certainly it is very frequently present in these cases. Indeed, it is not otherwise clear why obstruction should cause muscular hypertrophy in one individual and atrophy in another. This affection is often miscalled 'paralysis'; but it is quite distinct from true paralysis, consequent on disease or injury of the nervous centres. In paralysis the urine stagnates in the bladder through want of nervous stimulation of the muscular coat, not from impediment to its escape.

The *causes* of atony are: urethral stricture; prostatic hypertrophy or enlargement at the neck of the bladder; stone or tumour in the bladder; habitual fæcal distension of the rectum; repeated delays in emptying the charged bladder; sudden retention caused by gonorrhœal inflammation and swelling of the neck of the bladder.

Two forms of *stricture* cause habitual partial retention. One exists as a membranous band passing across the lumen of the urethra, near the meatus urinarius. Such a band, by exciting reflex spasm of the perineal muscles, causes habitual partial retention of urine. When more deeply placed, i.e. in the bulbous portion of the canal, the stricture has longer extent, and consists of induration of the submucous tissue. Such a contraction need not greatly diminish the size of the stream, and its existence may therefore not be suspected. *Prostatic hypertrophy*, chiefly affecting the middle lobe, in certain elderly men, may develop sufficiently to hinder the outflow also without materially lessening the size of the stream, though its force is weakened. Not only tumours produced by overgrowth of the prostate, but also those which form in the walls of the bladder, especially if placed near the floor, interfere with the proper contraction of the organ, and may give rise to atony of its coats. *Calculus* excites atony in bladders of which the muscular coat is degenerating, by the frequent calls to void urine it excites exhausting the contractile force. When atony or sluggish contraction is due to *distension of the rectum* and colon, the nutrition of the muscular tissue of the viscera generally is bad, and with the bladder thus predisposed to inertia, the mechanical impediment determines the distension. In women with the same predisposition, the gravid uterus sometimes causes atony. When this has happened, the bladder remains lax, and gets more and more distended, until a considerable abdominal tumour is formed.

Again, atony arises from neglect of the calls to micturate, either from hysterical perversity, or because some urethral affection makes the act painful, as in women who have a vascular tumour of the urethra. It is met with also in lethargic persons, with minds absorbed in mental occupation, who delay to empty the bladder, and so train it to over-distension. In this way the bladder may attain enormous dimensions. In one instance the writer drew off seven and a half pints from a bladder which reached to the epigastrium, and had been mistaken by the homœopath in attendance for a visceral cancer. Atony in young men occasionally follows what is called gonorrhœal retention: that is, the complete closure of the bladder by inflammatory swelling of the neck. Besides atony, this very painful affection may leave behind it, as sequelæ of the diminished evacuating power, cystitis, or interstitial nephritis, and thus gravely affect the patient's health.

The *symptoms* that attract the patient's attention to his condition are usually a slight discomfort and imperfection in voiding urine. The stream is a little delayed, wants force, and the terminal ejection is imperfect. Also, if the patient neglect the call to micturate, he finds the power somewhat impaired when he does begin. There is also some irritability of the bladder. Urine is voided more often than formerly. Sometimes a little pain is felt deeply in the perineum and the call to micturate is more imperative than in health. Or, the first symptom noticed may be involuntary discharge of small quantities of urine when the patient coughs or laughs—an occurrence that is generally attributed to loss of power to retain urine, not to the overflow of a really distended bladder. When stricture is the cause, the patient may have noticed a little whitish discharge from the urethra. With enlarged prostate, the patient is mainly annoyed by the necessity for rising at night to pass water, by the inconveniently frequent calls to micturate in the morning, and by troublesome oozing of urine into his dress. He generally complains that the stream will not come at once; he has to wait and strain a little. When stone or vesical tumour is concerned in the imperfect contraction, the symptoms of these affections usually overshadow those of simple distension.

When the overcharge has lasted a long time, or has followed gonorrhœa, catarrh or chronic cystitis begins. The urine becomes turbid, has a faint disagreeable odour, is often neutral or alkaline, and when time has allowed the mucus to subside, an opaque white deposit collects. If the affection has lasted several months, the urine may be ammoniacal or fetid, dark and very turbid, or even ropy, from a copious secretion of muco-pus. When this condition is present, the discomfort of the patient reaches absolute pain and distress. But in a considerable number of cases the condition has been so gradually produced, and the sufferings refer so vaguely to the bladder, from which, without ever quite emptying it, the patient expels with little difficulty about the usual amount of urine, that he often attributes his discomfort to troubled digestion, made irritable, partly through pressure and displacement of the viscera by the overfilled bladder, partly by their sympathetic disturbance. It is in such cases that the affection is often overlooked, or diagnosed as ascites or visceral tumour. When the patient is examined, the following conditions are discovered. In ordinary cases the distension of the bladder does not present a tumour obviously rising above the pubes, and the suspicion of atony is only proved to be correct by examination of the bladder. A bladder which has been gradually expanded during months or years through increasing relaxation of the walls, forms a tumour in the middle line that extends upwards from the pelvis towards or even into the epigastrium, or one of the hypochondriac regions. But even when the organ is so much distended as to invade the abdomen, the swelling does not resemble that of the healthy bladder when full. The swelling is ill-defined, and fluctuates readily on palpation. This character, combined with the unexpected height to which the tumour has mounted, often misleads the physician.

The existence of an imperfect evacuation of the bladder is ascertained by directing the patient to void urine; and then, having placed him in the horizontal position, if the collection of urine is large, by passing a catheter to draw off and measure the residue. As the urine escapes through the catheter, the want of contractile force will be shown by the stream subsiding to a dribble or stopping altogether, unless the bladder be artificially compressed by the hand on the abdomen, or by the patient's coughing or straining. The state of the urethra may be examined by passing a bullet bougie (No. 25 French scale) along the penile urethra to the bulb. Should a membranous contraction exist near the meatus, the passage of the bougie will be arrested, and the amount of the narrowing can be gauged by a smaller bougie. To detect stricture beyond the penile portion, the stem of the bougie must be bent that it may pass under the pubic arch, or an ordinary bougie of the same size may be used instead. This latter instrument will reveal stricture at the bulb, and by the way it stops at the neck or enters the bladder, will often indicate a prostatic enlargement. The diagnosis of atony arising from neglect or other non-obstructive cause is founded on the absence of obstruction, and by the presence of the signs appropriate to those causes.

Pathology.—Habitual retention favours attenuation of the coats of the viscus; the muscular fibres are small and pale; their contractile power is diminished, and in time is lost; the ureters and the pelves of the kidneys become dilated, and the pyramidal and cortical portions wasted or absorbed. Thus the secretive power of the glands is much lessened; and the consequences of imperfect depuration of the blood follow. The mucous membrane of the bladder and ureters and pelves becomes congested and inflamed. This slight chronic irritation is apt to become acute, and to cause fatal nephritis when the urine is withdrawn by catheter in cases of advanced degeneration of the kidneys. Under acute inflammation, the mucous membrane of the bladder grows dark red, or slaty, is marked by ulcers or shreddy patches of adherent pus, and the atrophied kidneys are destroyed by suppurative nephritis. In many cases, of course, the evidence of the disease which has occasioned the atony will be present in addition to those of the atony itself.

The *treatment* consists in attacking and removing the cause, or if that be not possible, in palliating its effects. If stricture be present, it must be widened until No. 20 of the French scale can be passed easily through it; meanwhile the bladder must be regularly emptied twice daily, or more frequently according to the amount of distension, to assist the contraction of the muscular coat by removing the strain. In simple cases the bladder often regains good tonicity and complete power of evacuation. The patient must be trained to pass the catheter himself once in twenty-four hours to ensure the complete evacuation of the urine, and to wash out the bladder through the catheter so long as mucus renders the urine turbid.

If these precautions are neglected, the evil will reappear. When no grave renal or vesical disease exists, the urine quickly recovers its normal acidity and clearness, and the bladder most of its tonicity.

When the atony has been slowly developed, and the expansion of the bladder has become very great, it is necessary to take precautions in the evacuation. The patient should lie down, and a body roller be applied, that as the urine escapes the pressure on the abdominal organs may be maintained, by drawing together the wrappings of the band. The whole quantity should not be removed at one sitting. When the bladder is so far relieved that it sinks into the pelvis, the rest of the urine may be left till next day and then withdrawn. If the urine is turbid, the bladder should be washed out with 6–8 ounces of cold water, containing one part in eighty of carbolic acid. The catheter should be carefully oiled before it is used, with weak carbolic oil, to prevent the introduction of septic agents. A common result after the abstraction of large collections of urine, is subacute cystitis, pyelitis, and fatal nephritis, due, it is believed, to the sudden removal of pressure from the kidney, and to the introduction of sepsis by the use of unpurified instruments. The catheter should always be withdrawn on each evacuation, until several days have elapsed. When the viscera have become accustomed to the absence of pressure from retained urine, and the urethra to the passage of the catheter, that instrument may be tied in, and the bladder kept constantly empty by continuous drainage through an india-rubber tube into a vessel under the patient's bed. The end of the tube should be submerged in carbolic water, as an antiseptic precaution. This rest to the coats of the bladder is a valuable restorative of the tonicity of the organ, and also useful for extinguishing chronic cystitis or vesical catarrh, should that be present. Contraction may be quickened by injecting three ounces of cold water (50° F.) into the bladder once or twice daily, according to the effect produced every time the urine is drawn off. Adjuvants to the cold water injection of the bladder, or its continuous drainage, are douches on the sacrum and pubes; small doses of copaiba, oil of sandal wood, &c. Most important aids are regular evacuation of the bowels, and also improvement of the patient's general health by tonics, sufficient exercise, and regularity of *régime* and diet in every particular. If practicable, warm sulphur baths and residence in a mild winter climate should be enjoined. By these aids to the regular evacuation of the bladder, the progress of renal disease is impeded, and life is prolonged and rendered enjoyable even when the tonic power of the organ is not thoroughly restored.

INFLAMMATION OF THE BLADDER.—*Cystitis, Acute and Chronic; Catarrh.*—Cystitis (inflammation of the mucous membrane of the bladder) has two forms—the chronic and the acute; the former being far more frequently met with than the latter. Usually the term 'catarrh' is limited to the chronic form, but not always so. In both forms inflammation of the bladder is a consequence of disease elsewhere, being, probably, never a primary affection. In the great majority of cases the affection is due to incomplete evacuation of urine, but many other causes may produce cystitis.

The obstructive causes are described under Atony of the Bladder, and need be only recapitulated here. They comprise stricture of the urethra; permanent enlargement or swelling and irritability of the prostate and vesiculæ seminales; gonorrhœal inflammation of the mucous membrane of the neck; stone or other foreign body; or tubercular disease or tumour. Special to women, as obstructive causes, are the pressure of the gravid uterus or of prolonged parturition, the irritation of a vascular growth in the urethra, or neglect to empty the bladder.

Among less frequent non-obstructive causes are—stone in the kidney; excessive coitus in elderly men; hæmorrhage and loaded rectum. Cessation of the catamenia sometimes excites cystitis. In weakly children of both sexes, but more frequently in scrofulous or rickety girls, cystitis occurs occasionally without any apparent obstruction to evacuation. Surgical processes, such as the passing or tying-in of catheters, sounding, the operations of lithotomy or of lithotrity, or for the removal of vesical tumours, will excite cystitis. Again, cantharides and, possibly, certain general conditions—such as the gouty diathesis, the debility accompanying typhoid fever or other visceral inflammations—are set down as causes of cystitis.

The chronic form is kindled generally by causes which, of slight effect at first, increase in severity with time. Acute cystitis is the result of sudden or of violent injury; the more dangerous form being that which follows severe operations on the bladder, or the acute congestion of an hypertrophied prostate. The less grave one is that which spreads from the prostatic urethra to the neck and floor of the bladder, but seldom extends over the whole surface of the mucous membrane. So, also, it is acute cystitis which sometimes occurs during the progress of other acute visceral inflammations, or from absorption of cantharides, or after operation on the rectum.

Pathology.—In the common chronic form, the mucous membrane of the floor of the bladder is swollen and uneven, being somewhat mammillated and softened. The colour is red in patches, from capillary engorgement. In long-standing cases, the small veins show as arborescent injection. This increased vascularity affects a larger surface the more the inflammation approaches acuteness. The patches are not evenly coloured; the little projections of the mucous surface being dull red, while the depressions may be of normal tint or even paler than natural. When the affection has lasted some time, the mucous membrane is hardened as well as thickened, but unevenly; some parts are more firm than others, and the red colour is replaced by ashy-grey patches scattered over a generally bluish-grey surface. To these ashy patches adhere layers of viscid exudation, dotted with small concretions of phosphate of lime. Again, in cases of long continuance, the mucous membrane is depressed into pouches where the adherent patches are thicker and more loaded with phosphates. After the inflammation has long continued in the bladder, the lining membrane of the ureters may undergo similar changes throughout their length, though it is usual for only the pelves and calyces of the kidneys (one or both) to be attacked. The pyramids and cortical tissue of the kidneys are also affected with interstitial nephritis and the changes of structure that follow that affection.

In the violent, acute form of cystitis, the bladder surface is very uneven, and of dark crimson colour throughout, approaching to black in the lower portions. The mucous membrane is much softened and destroyed in small areas; the muscular fibres may be exposed, or even perforated to the peritoneal cavity, allowing escape of urine and peritonitis. Whether the cavity be contracted by hypertrophy of the muscular coat, or simply dilated by yielding of the walls to the habitually excessive collection of urine, the inflammatory changes of the organ are not thereby affected.

The contents of the bladder after death vary in character with the amount of inflammation; in the limited chronic form it has a faint but peculiar odour, and is more or less turbid, with a purulent sediment in the *bas fond.* In cases of long standing, where the mucous membrane is indurated, the urine has a most nauseous odour, and contains plentiful flocculent mucous and phosphatic concretions, varying in size from a pin's head to a large pebble.

Symptoms.—In the early stages of the chronic form the symptoms are often too slight to excite the patient's attention, and consist in more frequent calls to evacuate urine that is turbid with muco-pus, and most so at the end of the flow. It is still acid or neutral, and not increased in quantity. If the urine is allowed to stand for a few hours, a light, opaque, white deposit forms of mucus and pus cells. The amount of muco-pus secreted increases greatly with the duration of the disease. It may remain long purulent and not streaky; but usually it becomes viscid, ropy, and of a greenish-yellow tint, settling with a dense deposit which adheres closely to the sides of the vessel which holds it. In this state the urine has a peculiar nauseous odour characteristic of cystitis. After the affection has lasted a few weeks the urine is often bright red from admixture of blood that has oozed from the congested blood-vessels. When the highly acute form is present, the urine is scanty in quantity, though the urgency for micturition is great; probably the diminished quantity is due to extension of the inflammation to the kidneys. The muco-pus is also less, though the urine is darkly coloured by extravasated blood. Though *pain* is at first absent, soon some uneasiness is felt after passing urine, for a few minutes, in the perineum and in the hypogastric region just above the pubes. After a while actual pain comes, and micturition, growing very frequent, causes severe smarting, most violent at the end of the act, when a few drops of pus or blood are expelled from the bladder. Sometimes this smarting is due to masses of gelatinous mucus impeding the flow of urine, and thereby increasing the spasmodic endeavours of the bladder to eject its contents. Behind the pubes also aching pain is felt, and a desire to void more urine when the flow has ceased. In very severe cases, when the bladder cannot get rid of all its contents, the aching pain may radiate to the groins, the insides of the thighs, and to the abdomen or loins. The bladder is tender to pressure of the finger in the rectum or above the pubes, and the organ can often be felt as a tumour lying behind the pubes. If there be partial distension from obstruction, these symptoms are increased.

The *constitutional disturbance* in the chronic form is nil, or amounts only to a sense of discomfort or uneasiness.

The *course and termination* in the chronic form depends greatly on the cause; when arising from moderate obstruction, the increase in severity is very slow. The removal of the cause, when that is possible, usually cures the disease, and it is said that both the chronic and acute varieties may subside spontaneously. At any time the acute form may be superadded, and the case then proceed rapidly and steadily to a fatal termination. The acute form arising from injury to the bladder is of short continuance. The constitutional disturbance is great. The temperature rises to 103° or 104° F., perhaps with a premonitory shiver, and is followed by tremulous pulse, restlessness, thirst, dry tongue, hiccough or vomiting, great prostration, and, if relief is not afforded, death in from four to twelve days. The severity of the sufferings depends greatly on the amount of obstruction that exists to the escape of urine. Should acute cystitis supervene upon a hæmorrhagic congestion from an hypertrophied prostate, the agony is excruciating and unceasing, and quickly exhausts the patient's strength. In most cases death results from implication of the kidneys in the inflammation, and their ultimate destruction. Less often the end is reached through peritonitis or septic blood-poisoning.

The *diagnosis* depends on the presence of increased frequency of micturition; of pain felt during and just after the act; of suprapubic pain or tenderness; of the mixture of pus and blood in the urine. Especially characteristic is the ejection of pus or blood at the end of micturition.

The *prognosis* depends on the cause. The chronic form is eminently curable if the cause be removed and the kidneys be not affected. Even if the cause still remain, unless it produce ulceration of the mucous membrane (such as a malignant growth), the affection may be palliated sufficiently to prevent suffering and the shortening of life. The less acute form, if speedily relieved, is also in most cases curable. Severe injury to the bladder usually excites inflammatory processes which extend beyond the organ itself, and the patient dies rather from the effects of the disease on other organs than from cystitis itself.

Treatment.—In all cases of cystitis the first step is to ensure that the bladder shall be completely emptied as often as is needful to restrain the frequent call to void urine. A good measure of the proper length of the intervals between the passings of the catheter is the number of hours of ease which the patient enjoys after the bladder has been cleared. As the irritation subsides, the catheter may be used only once or twice in twenty-four hours; but until the patient can completely empty his bladder naturally, the residual urine should be regularly removed for him. When required only once or twice a day, the patient will easily learn to perform this little operation for himself. If the cystitis be due to stricture of the urethra, widening of the contraction alone often suffices to cure the affection. Where the cause is enlarged prostate, regular evacuation of the bladder by instrument must be maintained for the remainder of the patient's life. In manipulating on such patients, the utmost gentleness must be observed, and small, pliant catheters employed that will slip past the obstruction readily. *See* CATHETERS.

If the call to micturate be very frequent, the effect of tying in a soft catheter should be tried—one of soft rubber if it can be passed—in order to drain the bladder continuously. Unfortunately this plan, though usually soothing, cannot always be carried out if the patient has not been previously accustomed to the passage of instruments; because in many persons the constant presence of a catheter soon excites pain at the neck of the bladder, with febrile disturbance and increase of the local inflammation. If this condition arise, the catheter must be removed, and be passed every three or four hours until the urethra has grown tolerant of the instrument. This usually happens in a few days, when the instrument may be tied in again. In certain cases also, though the constant presence of the catheter is borne, the viscid mucus chokes it, and the catheter must be removed for cleaning. Hence, in the majority of cases, the catheter should be passed when needed and not be tied in.

Injections, when the acuteness of the inflammation is past, are useful; but while that is at all acute, the mechanical distension of the bladder, however gently it is done, commonly gives pain. In the very severe traumatic form of acute cystitis, all that can be attempted is the injection of an ounce or two of tepid water to clear away or to dilute the thick mucus, when it clogs the eyes of the catheter.

In chronic cystitis, when the bladder is not tender on pressure, injections are a valuable resource. In the first place, the interior of a bladder is often so altered by imperfect contraction of the muscular coat, by sacculation, or by obstruction at the neck, that it is impossible to completely empty it. The warm water dilutes the residuum, washes out the remainder of the muco-pus, and thus replaces with simple water the small quantity of decomposing urine that irritates the mucous membrane. So, also, when the amount of mucus is small, and the catarrh due mainly to imperfect evacuation from atony of the bladder, a cold injection will stimulate muscular contraction. It must be moderately cool at first by using water of the temperature of the room; and, when the patient is habituated to that, by chilling the water artificially to 45° or 40° F. Certain astringent drugs dissolved in the water also appear to be beneficial. A valuable one is the sulphate of quinine, in the proportion of two grains and two minims of diluted sulphuric acid to the ounce of water.

If the urine be fœtid, or contain much pus, injection of this solution twice daily will clear away in three or four days all fœtor, and greatly check the secretion of pus. Quinine is especially serviceable when the urine contains free ammonia. When the deposit is mainly flocculent mucus, the nitrate of silver, one-fourth or one-half of a grain to the ounce, is sometimes beneficial, but it should always be discontinued if it cause pain. Sulphate of zinc or sulphate of copper may be employed in similar cases at the same strength. But all astringent salts are very uncertain remedies. Boracic acid and borax are soothing, perhaps more so than plain water; and they appear to check the formation of the tough mucus which clogs the catheter. The cold saturated solution of boracic acid must be warmed by immersing the bottle containing it in hot water before using it. A solution of borax, eight or ten grains to the ounce, with as much glycerine, appears to have the same effect in arresting the secretion of muco-pus. Carbolic acid, in the proportion of one part in sixty of water, is also employed to check inflammation and as a disinfectant, but the writer has not seen any other good result from the use of this agent. On the contrary, it is apt to cause pain and irritation, and hence should be used only in cases of chronic catarrh. As a purifier of the instruments used, carbolic acid may be added to the lubricating oil, in the proportion of 1 to 16, with advantage.

The mode of injecting is the same whatever solution is employed. An indiarubber bottle, holding four or six ounces, is fitted with a tap and nozzle which will enter the catheter. This is carefully filled to drive all the air from it, and when the urine has been drawn from the bladder, one or two ounces, according to the irritability of the viscus, are thrown in. The fluid must never be forcibly driven in, nor in quantity sufficient to cause pain. The injection is at once allowed to escape by removing the nozzle from the catheter. A fresh portion is then thrown in and run off until the fluid returns from the bladder clear of mucus.

The patient should always lie down when this operation is first practised; but when he has become used to it, especially if the bladder does not empty itself readily, he may stand up and lean against a wall during the washing. He can thus learn to wash the bladder himself, either with an elastic bottle, or with a glass funnel and a short length of indiarubber tubing, down which he can pour and extract successive portions of lotion until the bladder is clear.

In chronic cases, when the mucus is copious and tenacious, it is well to use a No. 20 or No. 22 (French scale) flexible catheter of single web and large eyes, to which a four-ounce bottle, with Weiss's wide tap, is fitted. This apparatus, being of great interior calibre, allows larger clots of mucus to escape from the bladder than will come through an instrument of fine bore. The bottle may be used also as an exhaust by allowing it to expand after compression, while still attached to the catheter. In this way, fœtid urine and tenacious clots can be sucked away from the bladder. The bottle must, of course, be refilled with clean solution two or three times during the operation.

Calculi and phosphatic concretions must be crushed and cleared away at one sitting: the sooner the better, unless the cystitis be very acute, when it is better to reduce the intensity of the inflammation by rest and drainage before submitting the patient to so severe an operation as lithotrity. The thorough removal of all foreign collections from the bladder usually cures the cystitis when it is due to this cause. This fact should be never forgotten when chronic cystitis follows lithotrity. In most cases it is due to a fragment of stone having been left in the bladder. The writer has seen thorough cleaning of the bladder cure cystitis for a time, even when a malignant growth in the wall of the bladder was the cause of the cystitis. Though the arrest of the cystitis was only temporary, the fortnight or three weeks passed without pain was very important to the patient.

There are certain cases of cystitis which do not yield to the methods described; for example, cases of large and very irritable prostate in old men, or of tubercular disease of the neck of the bladder in young men. Here, relief from the agony of constant, painful micturition can always be given by incision into the membranous urethra in the perineum between the bulb and the prostate, through which the bladder may be continuously drained. In tubercular ulceration the benefit is sometimes marvellous. In huge prostatic deformity the mere incision into the membranous portion is not always enough, and a tunnel through the substance of the prostate has been successfully made to give ease to the patient's suffering.

The general regimen of a patient with cystitis is important. Locomotion and exposure to cold must be scrupulously avoided. During the acute stages the patient must keep his bed absolutely. When the affection is subacute, he should stay in one room and be chiefly in the horizontal position. If sufficiently recovered to bear exercise, walking is better than driving in a chair or in a carriage. Long journeys should not be undertaken while any cystitis remains. A long railway journey has often excited a violently acute cystitis when the patient has been suffering from the chronic form or from urethritis. The body should be very warmly clad, especially the abdomen and the lower extremities, to produce free action of the skin. The diet should be light; all stimulants containing alcohol prohibited; also effervescent drinks, coffee, tea, and cocoa should be avoided, coffee and tea altogether, and cocoa taken only in small quantities and weak. Milk should be largely given, and if the kidneys are gravely affected, it may be, with or without ice, the only article swallowed. Where solid food is given, no more liquid should be drunk than is needed to quench thirst, that the secretion of urine may not be stimulated beyond what is unavoidable. Icing the barley-water, toast-and-water, or other drink, also renders it a better quencher of thirst, and therefore less will suffice. Of medicines which are reputed to affect cystitis, acute or chronic, directly, decoctions of triticum repens, or of alchimella arvensis, are perhaps the most likely to be effective; but their influence is very uncertain. To allay spasm and pain, opium and extract of belladonna are useful in suppositories. Belladonna must be cautiously employed, especially in elderly men, lest it increase the loss of tone of the muscular coat, and it should be given only when the pain is acute. In chronic catarrh, decoction of pareira brava with four or five minims of copaiba, or oil of sandal-wood in small doses, is useful. Benzoic acid in four-grain pills, at the rate of six or eight pills daily, is sometimes beneficial as a balsamic in chronic catarrh. More trustworthy in cases of subacute cystitis is buchu tea. Unfortunately, both pareira and buchu are apt to produce indigestion, and thus cause more discomfort than they allay. When given at all, they should be given in large quantities; in every twenty-four hours, 1 or 1½ pint of the decoction to be drunk, in three or four portions. Acids, except the mineral acids, in small tonic doses, are of no avail. Alkalinity of the urine in cystitis is due to the conversion of urea into carbonate of ammonia, and its production will be prevented by clearing the bladder of decomposing urine and pus. In cases of chronic cystitis due to atony, alkalies are chiefly beneficial when the patient is gouty and the urine highly acid.

For the acute cystitis which is a complication of gonorrhœal urethritis, the catheter is seldom needed, and injections would be mischievous. The *treatment* consists in the frequent use of sedatives in the form of very hot hip baths (104°–110° F.) for ten minutes, hot poultices, belladonna suppositories, eight to ten leeches to the perineum, subcutaneous injections of morphia, or of morphia and atropine, saline aperients, and low diet. Liquor potassæ, with tincture of henbane or of belladonna in camphor water, is also a very useful sedative in these cases. They may be given alone, or decoction of triticum repens may be given as well.

For old chronic cases, the winter should be passed in a warm climate; and a course of the sulphur waters at Bath, Strathpeffer, Harrogate, or Schlangenbad will greatly increase the tone of the bladder, and notably diminish, when it does not wholly remove, the muco-pus from the urine.

Neuralgia of the Bladder.—Pain, referred to the bladder, almost always to its neck, without actual disease of that part, is caused by a great variety of local affections and also by certain conditions of general disturbance. Nearly always the cause can be traced, and its removal cures the pain. Nevertheless, in a very few cases, the cause cannot be discovered: such, for want of a better knowledge of their origin, are termed *simple neuralgiæ*. In health the neck of the bladder is at all times highly sensitive, and often suffers from increased sensibility when other viscera are affected; while the remainder of the bladder, unless diseased (by inflammation or ulceration, for example), is probably quite insensible to the touch of foreign bodies.

The causes of painful conditions of the bladder, it has been already said, are most numerous. In respect of age, the middle age mainly suffers from this affection, though neither old age nor childhood is exempt. Of specific local causes, all which interfere with the evacuation of the bladder are sources of pain to this viscus—viz., stricture, enlargement of the prostate, calculi, gravel, atony of the bladder, tumours or indurations of its walls. The passage of sounds, falls on the perineum, pressure by the gravid or displaced uterus, constipation and loaded rectum, even excessive purging, may excite this form of pain. So, also, disease of the kidney, womb, or rectum; especially fissure of the anus, piles, or ascarides may set up nervous pain in the bladder. More distinct causes are disorders of the digestion, imperfect function of the liver or stomach, indulgence in certain alcoholic drinks such as punch, imperfect assimilation of food, or changes of tissue which produce highly acid urine or excess of uric acid, or the reverse—neutral urine with excess of phosphates. Exposure of the surface of the body to cold or a sedentary life are also causes of pain commencing in the neck of the bladder, but radiating widely elsewhere. Persons of rheumatic, gouty, or nervous constitution are prone to suffer from these pains. Excessive coitus and masturbation frequently set up pain at the neck of the bladder, principally through provoking long continued congestion of the erectile tissue and vascular structures placed there; probably also in part through the nervous prostration which follows these excesses. The debility resulting from long residence in hot moist climates, especially when the patient has suffered from malarial fever, both favours the production of the pain and increases its severity. Some of the most severe cases which the writer has seen have been in anæmic patients from India, the Straits' Settlements, or the Philippines.

The *symptoms* vary in different persons. Frequent calls to void urine are generally present, though not always so. Pain, usually intermittent—almost constant in severe cases—is felt in the perineum. It is variously described as an aching, as a sense of weight or of tightness, increased by sitting on a cushioned seat or when the sensitive neck of the bladder is pressed by the weight of the body. In some persons the pain is referred to the suprapubic region, in others to the symphysis. This form is more common in persons who indulge too much in stimulating food and drink. The pain is rarely confined to the localities just mentioned, but radiates to the groins, insides of the thighs, loins, sacrum, and lower part of the belly. It is often accompanied by depression of spirits and anxiety, or by irritable temper. The pain is usually worse by night than by day; that is, when the body is warm in bed and the genital organs congested by sleep. It is also very severe in persons of whose families some members suffer from ordinary gout, and who, though no local affection connected with the pudenda be detected in themselves, have eczema elsewhere more or less severely. In certain patients—usually those afflicted with dyspepsia—there is a tendency to spasm, and the patients are much alarmed by a liability to difficulty in micturition, which their fright may exaggerate to almost complete retention. Such spasm is, of course, quickly allayed by a hot hip-bath, a saline purge, or other simple remedy. In all cases the affection is very apt to return if the original cause be permitted to regain activity.

The *treatment* is general and local. The general treatment consists in removing the functional disturbance, if any exist; in ensuring the proper action of the digestive organs; in curing or alleviating any local ailment; in restoring the patient's strength; and, if there be any history of previous malarial attack, in using arsenic, bark, or quinine in full doses. A diet and regimen must be observed which will prevent the reproduction of the condition which favoured the excitation of the neuralgia. Thus the diet must be light but nutritious; alcohol must be most sparingly taken—to be wholly avoided in nearly all cases. Laxatives and diluent drinks, to render the urine of low specific gravity and of weak acidity, are needed. Long journeys are hurtful, particularly railway journeys, which in many persons excite prostatic congestion; and sexual commerce must be kept at a minimum.

The local treatment consists in the cure of any ailment discovered on careful examination of the urinary organs with the sound and finger in the rectum. When signs of disease are absent, the cautious passage of full-sized sounds at intervals of two or three days is often very effective. They may be followed by tepid injections into the bladder, slowly given, and at first not more than two or three ounces at a time; then increasing to six or eight ounces as the bladder becomes habituated to the distension. The injections may be cooled to 50° or 40° if the tepid ones fail to relieve pain. Tepid douches to the hypogastrium, perineum, or the sacro-lumbar regions, are sometimes beneficial. They should be applied for ten or twenty minutes if they cause no pain. Counter-irritation also, in the form of blisters to the perineum—small, and frequently repeated, are occasionally serviceable; but the writer has seen this remedy more often increase than allay vesical neuralgia. In some cases of general debility, without any marked functional derangement, local treatment has effected a complete cure in less than a month, but such success is not to be counted on. The most trustworthy treatment is a careful attention to diet and regimen, and to restoring the general health of the patient.

Berkeley Hill.

BLADDER, Extroversion of the. *See* Ectopia Vesicæ.

BLADDER, Puncture of the.—When a patient is suffering from retention of urine, from whatever cause, and the surgeon is unable to introduce a catheter, the bladder is punctured by trocar and canula, and the urine evacuated. The operation is occasionally employed in enlarged prostate, and tumours of the bladder and prostate, when acute retention of urine is not present. It is also practised by some surgeons in the treatment of certain forms of urethral stricture.

Before puncturing the bladder for retention of urine, the surgeon must satisfy himself that retention is really present, and must have made every effort to pass a catheter (*see* Retention of Urine).

The bladder may be aspirated above the pubes, or it may be tapped (1) above the pubes; (2) by the rectum; (3) from the perineum: (4) through the symphysis pubis; (5) under the symphysis pubis.

When there is hope that the relief from retention will only be required temporarily, *supra-pubic aspiration* of the bladder is the safest operation. Should retention recur, aspiration may be repeated two or three times with safety, and it has been performed ten or twelve times in immediate succession without bad result; at the same time it should be remembered that fatal extravasation and abscess have followed a second introduction of the needle. It will therefore be wise, if aspiration has to be several times repeated, to tap at once above the pubes with trocar and canula, leaving the canula or a catheter in the wound. Supra-pubic tapping ranks next to aspiration in safety and convenience. Rectal tapping is falling into disuse, owing to the obvious inconvenience it causes the patient. The other methods are surgical curiosities.

1. (*a*) Supra-pubic Aspiration of the Bladder consists in the introduction of a fine trocar into the bladder above the pubes, and in the withdrawal of the urine through the trocar by pneumatic aspiration. No anæsthetic is necessary. There are many aspirators sold, the best perhaps is usually called Potain's; it consists of an exhausting syringe attached to a cork, which can be fitted into a wine decanter or any other bottle sufficiently large, and through the cork also passes another tube connected with the trocar. The receiving bottle is exhausted. The patient lies upon his back with the knees slightly raised; an assistant steadies the distended bladder by pressing with his hands in each iliac region, and the trocar, having been carefully carbolised, is thrust through the skin about half an inch above the pubes downwards and backwards into the bladder; then a tap is turned and the urine flows into the receiver. Aspiration should be kept up during the removal of the canula, to prevent the escape of any urine into the tissues. This operation may be repeated perhaps twice or thrice, when, if no instrument can be passed by the natural passages, the surgeon is recommended to perform—(*b*) *Supra-pubic tapping.* It is desirable, but not absolutely necessary, to administer an anæsthetic. The pubes should be shaved, and a small incision made, about an inch long and ending half an inch above the pubes, through the skin and fat down to the linea alba. An assistant steadies the bladder, and a curved trocar (the ordinary rec-

tal trocar is very suitable) is then pushed through the linea alba downwards and backwards into the bladder. The urine is allowed to escape, and if the canula is a small one it can be tied in by tapes attached to a T-bandage and plaster. Or, better still, a soft catheter can be introduced through the canula and be tied in. After the canula is removed, a piece of tubing can be attached to the catheter, and the urine can thus be led into a receptacle by the side of the bed. The operation is simple and safe, and the bladder is easily drained until an instrument can be introduced through the urethra.

If for any reason the surgeon prefers to tap the bladder by the rectum it is done as follows:—

2. Rectal Puncture of the Bladder. The bowel is cleared by an enema, an anæsthetic administered, and the patient is held in the lithotomy position. While an assistant presses the bladder downwards the operator introduces the first and second fingers of his left hand into the bowel and defines the prostate, especially its upper border. He then takes the rectal trocar in his right hand, *with the point drawn just inside the canula*, and introduces the instrument along the groove between his two fingers which are lying in the rectum, until it has fully passed the posterior margin of the prostate. The handle is then firmly depressed, and the trocar and canula are thus pushed into the bladder. After the urine is drawn off the canula can be removed or retained as the surgeon deems best. This operation has many disadvantages. It is somewhat dangerous and may lead to troublesome fistula. It can rarely be required now.

3. Puncture through the Perineum. A large, straight trocar and canula are used. The patient is held in the lithotomy position. The surgeon's left forefinger is passed into the rectum, and the trocar is thrust into the perineum about an inch above the anus and pushed, upwards and backwards, into the bladder. The canula can be retained.

4. Puncture through the Symphysis Pubis.—A medium-sized hydrocele trocar is used. It is introduced, without preliminary incision, through the centre of the symphysis, and pushed downwards and backwards into the bladder.

5. Puncture under the Symphysis Pubis.—The penis is forcibly pulled downwards and backwards and the trocar thrust under the pubes into the bladder.

G. Buckston Browne.

BLADDER, Rupture of the, is a breach in the vesical wall, caused either by external violence, or by forces acting within the body itself. In the former case the rupture is *traumatic*: in the latter *idiopathic*. In either form ruptures fall naturally under two heads: *extraperitoneal* and *intraperitoneal*; the former including (*a*) *partial* ruptures, or rents in the mucous coat only, or in the mucous with part of the muscular; and (*b*) the important group of *subperitoneal* ruptures. Occasionally multiple rents are found in an injured bladder.

1. The *causes* of ruptures are divisible into *predisposing* and *determining*. Distension of the bladder is the main predisposing condition of an uncomplicated traumatic intraperitoneal rupture, and is present in the great majority of instances of ruptures of all kinds. When the viscus is empty, or contains but a small quantity of urine, a rent in the bladder anteriorly may be occasioned: (*a*) by a fractured pubic ramus; (*b*) by great violence applied to the hypogastric region, as when the wheel of a heavily laden waggon passes over the abdomen, or a mass of earth falls on the part; and (*c*) by the same force by which the innominate bones are violently separated at the symphysis pubis. The base of the bladder may also be split by disruptive force, which tears open the perineum and lacerates the rectum. Other predisposing causes are intoxication, and some obstacle to the passage of urine from the bladder. Differences of habit and occupation render males far more liable than females to rupture of the bladder. In the *traumatic* cases the determining cause is usually some force applied to the hypogastric region. Even the strain of the abdominal muscles against the distended bladder in falls backwards, and lifting heavy weights, may suffice to occasion the lesion. Violence applied to the back has also been noted as a cause of rupture in several cases. The site of the rent will depend upon the degree of distension, the nature and mode of application of the violence, and the position of weak spots in the bladder-wall.

Idiopathic ruptures include all cases in which no external violence has been applied to the abdomen; ruptures from over-distension due to various causes, as, e.g., stricture, enlargement of the prostate, hysteria, retroversion of the gravid uterus, extra-uterine fœtation, labour, and alcoholism; ruptures in the fœtus, and ruptures due to ulceration, the result of certain diseases, viz. fever, erysipelas, syphilis, tubercle, cancer, and calculus.

2. *Pathology.*—In the *idiopathic* cases rupture is often preceded by some change in the organ itself. Thus long-continued obstruction to the passage of urine, whether from stricture or enlargement of the prostate gland, occasions hypertrophy of the muscular fibres of the bladder, and the formation of 'tunicary herniæ,' or diverticula of the mucous membrane, which protrude through the muscular fibres, commonly either at or near the summit of the bladder, or posteriorly at the level of the insertion of the ureters. As these pouches are sometimes immediately under the peritoneal tunic, and sometimes unconnected with the serous coverings, ruptures due to stricture or hypertrophy of the prostate may be either intraperitoneal or extraperitoneal. A second condition, occasioned by obstruction of the urethra, especially when instruments have been passed, is inflammation of the mucous membrane of the bladder, determined, perhaps, by decomposition of retained urine. The inflammation may end in ulceration, softening, sloughing, or gangrene of some spot in the bladder-wall, a termination exemplified in cases of rupture from retroversion of the gravid uterus, and some prostatic cases. A third effect of obstruction is thinning and weakening of the vesical tunics. The final cause of rupture may be muscular action in efforts to pass water, and straining at stool. In rupture during labour the neglected and distended bladder is placed between two forces, the contraction of the abdominal muscles and some part of the child's body, or the forceps of the medical practitioner. The rent may either be into the peritoneal cavity or into the vagina. After the completion of labour rupture may occur sooner or later in consequence of the injury sustained by the bladder during the process, and from subsequent neglect.

Each kind of rupture has its own form of breach in the bladder-wall. The ordinary form of uncomplicated rupture from blows, kicks, and falls, is a lacerated rent, one inch to three inches in length, vertical, oblique, or transverse. The more or less vertical rent at the upper part of the posterior wall of the bladder, commencing near the urachus, is the most typical, and results from the sudden application of equable violence to the hypogastric region, driving the fluid against the posterior wall, which is burst open by the expanding force. In retroversion of the gravid uterus, the opening is either a rent with gangrenous edges, or a sloughy hole or gangrenous perforation. In cases of stricture and retention, where the rupture follows over-distension and straining, the aperture is usually a small perforation, or a short rent of about half an inch, or a triquetrous opening, or a round hole lined by mucous membrane. In cases of hypertrophy of the prostate, the opening may be smooth and rounded, or a narrow rupture with thinned or sloughy edges.

In *traumatic* cases blood is often poured out freely. Submucous extravasation will be found, either confined to the neighbourhood of the rent, or spread over a wider area. A considerable amount of blood has been found in some intraperitoneal ruptures in the cavity of the abdomen, whilst in some of the extraperitoneal cases blood may collect and form a swelling in the hypogastric region. After rupture the bladder either collapses or contracts, and is usually incapable of holding more than a few ounces of urine.

3. *Symptoms.* — The typical primary symptoms of rupture are a feeling of something giving way, excruciating pain, shock, inability to stand or walk, desire, but want of power, to micturate, and removal from the bladder with the catheter of blood only, or a small quantity of bloody urine. When the point of the catheter impinges against a sound portion of the viscus, it will be found difficult to rotate the instrument and to depress it between the patient's thighs, but if there is an intraperitoneal rent on the posterior wall, the catheter may suddenly slip through the opening into the peritoneal cavity, become freely movable, and withdraw a large quantity of fluid in place of the small quantity of blood, or the few ounces of blood and urine, previously removed. As the contraction of the muscular fibres of the bladder cannot assist the flow, and as the abdominal muscles are exerted only for the business of respiration, the urine will either well out gradually and run down by the side of the catheter, come out almost *guttatim*, or pass from the instrument in an intermittent stream during the periods either of inspiration or expiration. As a general rule the patient from the first is unable to make water, and may continue to exhibit this inability to the end. Ability to micturate, however, has been observed both in intraperitoneal and extraperitoneal cases, and in both sexes. It is relatively more frequent and in greater perfection in the extraperitoneal cases. Sometimes the patient passes water, with or without difficulty, immediately after the accident, and not subsequently, sometimes in small quantities throughout the illness, sometimes on the second or third day, and

sometimes at a later period. When passed it is generally with difficulty, and the amount will be less than it ought to be. Occasionally there will be incontinence of urine. Very rarely indeed the patient may pass water naturally every day and be independent of the catheter.

In the *intraperitoneal* ruptures the symptoms are decidedly more severe than in the extraperitoneal cases. The shock at first is greater and the well-known symptoms of peritonitis speedily supervene. The patient will lie in bed with his knees drawn up, or be propped up with pillows, to relax the abdominal muscles. He will have a pinched, anxious, haggard, and even ghastly expression of countenance, look pale and anæmic, and be tormented with a frequent or constant desire to pass water, leading him to make many ineffectual efforts to empty his bladder. He will suffer from thirst, and sooner or later be troubled with vomiting, bringing up a greenish-yellow liquid, and even the water which he has drunk copiously to quench his thirst. The pulse will be small, feeble, irregular, and rapid, varying between 90 and 130, and the respirations hurried. The abdomen will be tense and tender, tympanitic above, dull and fluctuating below. There may even be a more or less defined and fluctuating swelling, resembling the bladder, between the umbilicus and the pubes, due to urine temporarily confined by the disposition of the coils of intestine. Throughout the illness there will be marked restlessness and insomnia. As the case proceeds, the symptoms become aggravated, the swelling and tension of the abdomen increase, clammy sweats appear on the skin, the hiccough and vomiting become more urgent and distressing, the pain is intolerable, the countenance sunken and ghastly, the voice low and feeble, and the patient may sink into a state of collapse, or into a typhoid condition attended with delirium and coma. If the patient survive so long, there may be marked signs of amendment about the fifth or sixth day. The rent in the bladder is under repair, or gets blocked up by intestine or omentum, and the patient may sit up in bed, pass water voluntarily, take food without rejecting it, be freer from pain and comparatively cheerful. Relapse speedily occurs, and the patient sinks.

In *extraperitoneal* cases, the general and local symptoms will be those usually attending extravasation of urine. When the rent is in front, the urine either forms a circumscribed collection outside and anteriorly to the bladder, occasioning marked dulness on percussion; or it becomes widely diffused, mounting up towards the umbilicus between the peritoneum and abdominal muscles, and then finding its way to the subcutaneous fascia or into the peritoneum, or passing into the iliac fossæ, or through the obturator foramina and the inguinal and femoral canals into the scrotum and thigh. When the rent is behind the prostate, the fluid will ascend into one or other of the iliac fossæ. Wherever extravasation occurs it sets up inflammation of the connective tissue and fasciæ, followed in due time by suppuration and sloughing. Occasionally the urine is collected in a kind of sacculus, the walls of which are composed of connective tissue thickened by lymph, simulating the appearance of a lining membrane to the adventitious cavity.

Diagnosis.—The chief mistakes which occur in practice are: 1. Overlooking the lesion altogether, or mistaking it for some other affection, such as peritonitis. 2. Mistaking an extra-peritoneal for an intraperitoneal rupture. 3. Mistaking a contusion of the bladder or of the abdomen for a rupture of the bladder.

The first mistake is not likely to occur to a well-informed and sagacious practitioner, if the case is typical. Clear evidence of fulness of the bladder at the time of the accident, of violence applied to the hypogastric region, of the occurrence of the typical primary symptoms, and the results of examination of the bladder and abdomen, will establish the diagnosis beyond a doubt. But the surgeon may have to do with a patient under the influence of alcohol, who recollects nothing, and felt nothing of the accident, and he may have to trust mainly to his own skill in interpreting symptoms and in manual and instrumental examination. The behaviour of the catheter, the nature and quantity of the fluid withdrawn by it, and the total or restricted ability of the patient to micturate, will be the most reliable guides. If these are insufficient, the bladder can be injected with a warm solution of thymol. If the bladder be sound, it will form a circumscribed tumour in the hypogastric region, and the fluid will be recoverable; if ruptured, the fluid will become diffused among the intestinal coils, be felt by the patient in the flanks, and will not return readily or completely through the catheter.

The second mistake will be less likely to occur if the surgeon carefully considers the mode of occurrence of the injury, whether it is complicated by fracture or not, and the effects of catheterism. In extraperitoneal ruptures, fracture of the pelvis is a frequent cause or accompaniment of the bladder-lesion; the primary symptoms are less marked, the constitutional condition less serious, the catheter rarely leaves the bladder, and evidence of extravasation in the hypogastric region, flanks, scrotum, or thighs, will soon be forthcoming. If the surgeon is satisfied that the bladder is ruptured, but cannot arrive at a certain conclusion as to the kind of rupture present, he can either explore the bladder from the perineum, or make an incision immediately above the pubes, and examine the anterior aspect of the organ, before proceeding to open the peritoneum.

The third mistake arises chiefly from over-estimating the amount of urine in the bladder at the time of the accident; through attending to the time which has elapsed since micturition without regard to the quantity of liquid ingested; from forgetting that the secretion of urine is often either suppressed or greatly diminished for some hours after severe abdominal contusion; and from regarding the passage of a catheter by a medical practitioner, and failure to draw off urine, as necessarily indicating an empty bladder.

Treatment.—As there is no indubitable case of spontaneous recovery on record after intraperitoneal rupture of the bladder, it is essential that the surgeon should form his diagnosis immediately, and act without delay. The indications are mainly two: first, the removal of the effused urine, and secondly, the prevention of the further escape of urine through the rent in the bladder into the perivesical connective tissue or the peritoneal cavity. For these purposes the intermittent use or constant retention of a *catheter* in the bladder, attempted *washing out* of the peritoneal cavity or adventitious pouch in the perivesical fascia through the rent in the bladder, *tapping* the recto-vesical cul-de-sac, and *paracentesis abdominis*, either with an ordinary trocar or the aspirator, are not trustworthy.

The peritoneal cavity can only be efficiently cleared of urine and blood by *abdominal section* and careful and thorough sponging. Prevention of further accumulation and transmission of urine into the peritoneal sac in the male may be secured by sewing up the rent in the bladder with carbolised silk sutures, with or without paring the edges of the ragged rent. If this procedure be adopted, the bladder should be injected with water before the abdominal wound is closed, to make sure that leakage is not possible. Perineal urethrotomy, either median or lateral, should then be performed, the lateral operation being preferable. A tube can be retained in the bladder. Some surgeons prefer the performance of perineal urethrotomy or cystotomy in the first instance, and abdominal section afterwards, and if there is any doubt as to the diagnosis, a preliminary exploration of the bladder would remove it; otherwise the sequence of procedures cannot make any difference. After the operation, hypodermic injections of morphia will be of service. Abdominal section ought to be performed within the first twenty-four hours to have a good prospect of success, and further experience is required to test the value of all operative measures.

In the female, intraperitoneal rupture of the bladder should be treated by vaginal cystotomy and abdominal section, with careful cleansing of the peritoneal cavity.

In extraperitoneal ruptures, cystotomy, combined with incisions above the pubes and into any parts where extravasated urine finds its way, will offer the best prospect for the patient. WALTER RIVINGTON.

BLADDER, Tumours of the.—Tumours of various kinds have long been recognised as affecting equally the male and female bladder. Those of a cancerous nature have been more familiar to surgeons than other forms of less malignant tendency, and hitherto accounted rare. During the last ten years the latter have been studied, and also found removable by operation in some instances, a condition which does not characterise cancerous growths.

The greater number of these, namely, twenty-three cases, have occurred in the experience of the writer; hence the result of his researches will form the chief basis of the present article.

Tumours of the bladder may be classified as follows:—I. Tumours composed of homœoplastic elements.

1. The *simple mucous polypus* at present met with only in the bladders of children, and mostly appearing to be analogous in structure to the soft nasal polypus, a form of myxoma; while occasional specimens contain, in addition, more of the deeper normal fibres of the structures from which the growth arises. The growths are numerous, evidently rapidly formed, soon fill the bladder, and in the case of female children sometimes issue by the external meatus, and present in the vagina.

2. *Papillomatous Tumours.*

a. Fimbriated Papilloma is now held to designate that product which has been familiarly known as the 'villous' growth, a term which is objectionable on several grounds. The most obvious character of the growth is a structure in which the vesical mucous membrane is developed into fine papillæ, which consist of long fimbriated processes of extreme tenuity, and usually form a group arising from a small circumscribed base.

b. Fibro-Papilloma. Here the papillary processes, although present in more or less abundance, do not constitute the chief part of the structure, which is more solid than the preceding, and consists of the constituents—unstriped muscle and connective-tissue fibres—of the submucous tissues of the vesical coats. The papillæ are sometimes shorter, less developed than, the 'fimbriated' processes of the previous division.

3. *Transitional Tumours.*—This term is for the present used to designate certain examples of tumour, the chief structure of which is that of 'fibro-papilloma' just described; but presenting also, intermixed, some suspicious-looking cells, which may be merely leucocytes, but which may sometimes suggest to the observer that the growth is intermediate in structure between the foregoing and a formation of a malignant type, 'sarcoma.'

The three foregoing varieties are, comparatively speaking, by no means uncommon.

II. Tumours composed of heteroplastic elements:—

a. Epithelioma.

b. Sarcomata, round and spindle celled; rare.

c. Scirrhous, encephaloid, and melanoid cancers.

d. Dermoid tumour; rare.

Symptoms.—Regarding the forms most commonly met with, or those of the first group, the earliest symptom is mostly hæmorrhage; and it occurs before unduly frequent micturition is complained of, and before it is painful. On the other hand, when the tumour is of the malignant type or approaches thereto, pain and frequency of passing water generally precede the appearance of blood, sometimes for a considerable time. There is nothing very characteristic in the hæmorrhage, excepting the one important circumstance always to be inquired for, and, if possible, to be observed by the surgeon himself; namely, that in the act of micturition the stream may sometimes commence without any blood-stain, or with only a slight admixture, and end of a bright red colour from the presence of much fresh blood. With such an occurrence, and no recent urethral lesion having been made, the source of hæmorrhage must almost always be vesical. Supposing in such circumstances that the absence of stricture, ordinary diseases of the prostate, calculus of the bladder, and cancer have been ascertained by sounding and by rectal examination, it remains only to observe certain products which the urine itself may contain.

Very little positive evidence is obtained by rectal and vesical examination except in hard, cancerous deposits, which are thus easy to identify. The result is generally negative, or nearly so, when a growth of the papillomatous or of the allied variety is present.

The examination of the urine, however, is highly important. Its object is to obtain disintegrated portions of the tumour if present, and to identify their structure under the microscope. An excellent way of obtaining such specimens is to wash out the bladder freely with warm water. It rarely happens that this process fails to detach fragments sufficient for our purpose if there is a growth in the interior.

The presence of a non-cancerous tumour being verified or strongly suspected, the bladder should be explored, and the tumour removed if practicable; no other treatment is of any service. The best mode of accomplishing this is by external urethrotomy, a simple procedure involving little or no risk, and not by cystotomy—some rare cases excepted—since it is always more or less dangerous.

Operation.—The steps of the operation which the writer adopts are as follows:—The position of the patient and the accessories are the same as for lithotomy. A median staff with a short curve, deeply grooved, is passed into the bladder, and the patient is held by two assistants in the usual manner, another holding the staff. The surgeon introduces into the rectum his left forefinger, so as to feel with its tip the position of the grooved staff, and verify the apex of the prostate, on which he places his finger as a guide. Maintaining his left index in the position described, he makes, with a long, narrow, straight-backed bistoury, a vertical incision through the skin and cellular tissue in the middle line, about an inch and a quarter long, the lower end terminating about three quarters of an inch above the anus. He next enters the bistoury, with its cutting edge upwards, in a horizontal direction, at the lower part of the incision, just above the upper border of the bowel and parallel with it, and guided partially by the left index, directs the point to the membranous urethra, which it penetrates, entering firmly the groove of the staff. He then incises the urethra on the staff for a few lines, and withdraws the bistoury, cutting slightly a little of the tissues upwards as he does so, avoiding as far as possible any section of the bulb itself, and making room enough only for the finger to enter. He now inserts in the groove of the staff a tapering director and presses it inwards along the urethra to the bladder: when arrived there the staff is withdrawn, the director remaining, and on it the left index is gently insinuated to the neck of the bladder, entering which, he at once recognises the form and position of the growth, and determines whether he can or cannot attempt to remove it.

If the surgeon finds a polypoid growth he should introduce a pair of forceps into the cavity of the bladder, and use them without aid from the finger. The forceps should have wide and serrated margins where the blades meet, so as to crush, but without power to cut, the tissues seized, and should be provided in different forms. The simplest should be like an ordinary lithotomy forceps. Others should be curved, for seizing tumours which are situated laterally and near to the neck of the bladder, in which last-named position the straight forceps is powerless to grasp the tumour. When the blades are free, if they are opened easily and widely, the polypus is almost sure to be within their grasp. No suprapubic pressure, as a rule, should be made during this act, so as to disturb the contour of the bladder. He should never drag or pull forcibly, but rather 'bite' off the growth with the blades, twisting it somewhat perhaps. After this the finger alone may often remove it safely. Every time the forceps has removed a portion, the finger should examine the interior, before the forceps is introduced again. And in no case where the tumour is a flattened growth with broad base, should an attempt be made to separate it very near to the walls of the bladder, which might thus be fatally injured.

There is one circumstance important to be noted, especially in dealing with the less prominent growths, viz., the effect of strong supra-pubic pressure made by an assistant in relation to their mode of presentation to the finger of the operator engaged in exploring the bladder, and in estimating their size and form. If that pressure is considerable, it forces the upper wall of the bladder into its own cavity, and thus gives to the growths a larger contour than they possess, and makes them apparently salient to a much greater extent than they really are. Thus an eager or inexperienced operator, unaware of the effect of supra-pubic pressure, might be led to seize the mass presented to the forceps by the influence of this pressure, and, under the belief that it was a large growth, he might inflict a fatal wound by crushing a double fold of the coats of the bladder, and so making an opening in the peritoneum. To avoid such a catastrophe it is only necessary, first, to decline the attempt to destroy any growth which is clearly not sufficiently salient to admit of complete or nearly complete removal; and, secondly, never to employ the forceps while forcible supra-pubic pressure is made—at least, no more pressure than is desirable just to steady and support the bladder and the parts adjacent.

But other means may be used according to the judgment of the surgeon. A very small écraseur, with violin-string ligature, may be manipulated by the side of the index finger, and used in polypoid forms of tumour. In the cases of women such a tumour may sometimes be slowly and carefully brought into view by traction on the forceps, and then the pedicle may be ligatured, as the writer has done in two instances.

After the operation a tube has usually been introduced and left for two or three days. As a rule, however, it appears advisable not to employ one.

It may be remarked, as before observed, that the incisions necessary for the proceeding are simple and harmless to the last degree. The writer has never met with any untoward result from them. The risk of removing the tumour is, however, sometimes considerable, but even this depends very much on the care, judgment, and self-command of the operator. It is not at all difficult to inflict fatal injury on the organ by an attempt to remove a growth either too completely or too vigorously.

There is good reason to believe that entire removal of the base of papillomatous formations is not absolutely necessary, and that cicatrisation prevents further development where the growth has been nearly, and not quite, removed.

The presence of cancerous disease of the bladder, and especially the scirrhous variety, may almost always be determined by rectal examination: the irregular knotty feel of the hard deposit in the situation of the prostate and beyond it are quite characteristic. Such a condition, associated with much pain, occasional bleedings, and frequent micturition, go far to establish the diagnosis. In regard to treatment, that only which renders life endurable by alleviating sufferings which inevitably become severe in the later stages of the disease, is desirable; and it consists in the administration of morphia, the subcutaneous injection being the most efficient form in these cases. It may here be emphatically stated that if the physical characters and symptoms, especially the former, indicate the presence of a growth of this nature, any operative proceedings for its removal must be not merely futile and imperfect, but extremely dangerous, and ought not to be undertaken. It does not follow, however, that in such cases the drainage of the bladder by a perineal opening may not, in certain circumstances, be a useful proceeding to relieve suffering or prolong life, &c. HENRY THOMPSON.

BLEBS. *See* BULLÆ.

BLENNORRHAGIA. *See* GONORRHŒA.

BLEPHARITIS. *See* EYELIDS, Diseases of the.

BLINDNESS.—The term blindness is used in two senses—a strict or scientific sense, in which it means inability to distinguish light from darkness, and a loose or popular sense, which may mean any condition impairing vision, or, indeed, mere temporary incapacity for opening the lids, vision being otherwise perfectly preserved. In the true sense, when the patient has no longer even quantitative perception of light, blindness is always the result of some lesion of the nervous system, such disease having its seat either in the recipient apparatus or retina, in the conducting apparatus, optic nerve, chiasma, or tract, in the percipient apparatus or corpora quadrigemina and optic thalami, or, lastly, in the intellectual visual centre; situated, according to some, in the occipital lobes of the cerebrum, and, according to others, in the angular gyrus, the tract or fibres of Wernicke establishing the communication between the corpora quadrigemina and the cortex cerebri in the former case, and radiating fibres effecting the transmission of the impressions in the latter case. Congenital defects, traumatic lesions, hæmorrhage, inflammation and its consequences, syphilitic and other tumours of the brain, may attack, compress, or destroy any of these parts, and total blindness of one or both eyes may be the result.

It is impossible to determine from the censuses of this country whether those who are termed blind are only blind so far as to prevent their being educated, or obtaining their own living, or whether they are wholly incapable of perceiving light. Moreover, no clear distinction is drawn between cases of complete blindness and those in which, whilst one eye is really blind, the other still retains some perception of light.

The present article will be devoted to the consideration, not only of the completely blind, but also of those cases of great impairment of vision which, whilst varying from mere perception of light to the recognition of large objects, yet practically render the subject unable to pursue any of the ordinary vocations of life. It is, indeed, very difficult to draw any line between mere weakness of sight and blindness. There are cases, for example, of astigmatism, of cataract, and of retinal or choroidal atrophy, in which vision may be assisted, and even rendered tolerably good for a short period or for certain purposes, but, as a whole, may prove insufficient for the ordinary duties of everyday life.

It is found convenient in practice to distinguish three degrees of blindness:—(1) Complete blindness, in which there is no perception of light. Vision is then said to be abolished; $V = 0$. (2) That degree of blindness in which only the difference between light and darkness can be distinguished; $V = \frac{1}{\infty}$. The patient is then sometimes said to possess quantitative perception of light; and, thirdly, that degree in which there is qualitative perception of light, expressed by $V = \frac{1}{1000}$. In this degree the patient can distinguish large objects, masses of colour, the movement of the hand between the eye and the light, and may, perhaps, even be able to count the fingers, but is unable to do more than grope his way from place to place.

Distribution of Blind Persons.—The distribution of the blind varies considerably in different areas. Thus, in the census of France in 1861, the number of blind in the Départément du Vendée was only 24 in 100,000 inhabitants, whilst in the department of Eure it was as high as 121 in the same number, a difference too striking to be attributable to defective registration.

The census returns for 1881, published in 1883, contain many interesting facts in regard to the number, distribution, and occupation of the blind in England and Wales. The total population is given at

25,974,439, and the total number of blind is returned at 22,832. Of these, 1,958 were blind from birth, a large proportion of them probably in consequence of an attack of purulent ophthalmia. Of the 22,832 blind, 12,048 are males, 10,784 are females. The distribution of the blind in England is as follows:—

Counties	Total Population	Number of Blind	Males	Females	Blind from Birth
Northern:—					
Durham	1,624,213	1,259	723	536	112
Northumberland . . .					
Cumberland					
Westmoreland . . .					
Yorkshire	1,420,001	2,294	1,234	1,060	223
North-Western:—					
Cheshire	4,108,184	3,004	1,628	1,376	317
Lancashire					
North-Midland:—					
Leicestershire . . .	1,637,865	1,429	733	696	129
Rutlandshire					
Lincolnshire					
Nottinghamshire . . .					
Derbyshire					
West-Midland:—					
Gloucestershire . . .	3,029,504	2,914	1,606	1,308	267
Herefordshire . . .					
Shropshire					
Staffordshire					
Worcestershire . . .					
Warwickshire					
South-Western:—					
Wiltshire	1,859,013	2,354	1,257	1,097	174
Dorsetshire					
Devonshire					
Cornwall					
Somersetshire					
Eastern—					
Essex	1,343,524	1,308	673	635	127
Suffolk					
Norfolk					
South-Midland:—					
Middlesex, excluding London	1,596,259	1,434	694	740	119
Hertfordshire					
Bucks					
Oxfordshire					
Northamptonshire . . .					
Huntingdonshire . . .					
Bedfordshire					
Cambridgeshire . . .					
South-Eastern:—					
Surrey	2,487,076	2,025	1,022	1,003	156
Kent					
Sussex					
Hampshire					
Berkshire					
London, including parts of					
Middlesex	3,816,483	3,214	1,551	1,663	252
Surrey					
Kent					

The following statistics, showing the steady decrease of blindness in the population—the result, it is to be hoped, of improved knowledge and care in treatment of diseases of the eye of all kinds—are interesting :—

	Number of Blind	Number of Blind in one million	Number Blind of one eye
1857	18,306	1,021	979
1861	19,352	964	1,037
1871	21,590	951	1,052
1881	22,832	879	1,138

Number of blind in one million of persons of the same age :—

Age	Both Sexes	Males	Females
0	166	172	161
5	288	312	263
15	388	449	328
20	422	491	359
25	645	800	494
45	1,625	1,947	1,326
65 and above	6,715	6,897	6,929
Mean	879	953	809

These figures must, however, be regarded as only approximations to the truth, for the instructive essay of Zehender shows only too well how fallacious such statistics may be, for in the official census of Mecklenburgh-Strelitz, the number of blind persons was returned at 480, but of these Zehender ascertained that 16, or 3½ per cent., were not totally blind, whilst in Mecklenburgh-Strelitz out of 73 returned blind, 5, or 7 per cent., were not blind ; and on the other hand, in the former State 48, and in the latter 12 totally blind persons had been overlooked. The same defects of enumeration would probably be found in all censuses ; but, even if this be allowed, it is still found that, in the geographical distribution of blindness, great differences exist in different countries. Thus in Holland the proportion is only 4·45 per 10,000 ; in Austria, 5·5 in the same number ; United States, between 30° and 40° lat. 6·36, between 40° and 50° 4·65, including Canada. The author of the article 'Blindness' in the *Encyclopædia Americana* (1883), gives the proportion as 8·75 for America generally ; Switzerland, 7·61 ; Sweden, 8·05 ; Belgium, 8·1 ; France, 8·36 ; Germany, 8·79 ; England, 9·84 ; Italy, 10·15 ; Spain, 11·09 ; Hungary, 12·01 ; Norway, 13·63 ; while in Finland it reaches the number of 22·45 in every 10,000 of the population. It is somewhat remarkable that the Jews have a higher proportion of blind than the Christians, in Germany the numbers being about 8 per 10,000 amongst Christians, and about 12 per 10,000 in Jews.

Etiology of Blindness.—Blindness is more common in hot and in cold climates than in temperate, from causes that may easily be conceived. In hot climates the glare and heat of the sun, combined with the dryness of the atmosphere, the deficiency of water for purposes of ablution, the extraordinary number of flies and other insects, and perhaps the greater activity of all germs of disease, render inflammatory affections common, and every traveller notices the frequency of ophthalmic disease and of cases of blindness in Egypt, Palestine, and India. On the other hand, in the Arctic regions, and especially in Finland, where the proportion of blind persons rises to a higher number than in any other nation, blindness is, of frequent occurrence, partly, no doubt, owing to exposure to cold, and the strong reflection from the surface of the snow, but chiefly owing to the unwholesome hygienic conditions that are constantly present. The huts are overcrowded ; men and animals live in close proximity with each other, and the inadequate provision for the escape of smoke, and of the exhalations from the skin, constitute precisely those conditions which every physiologist would acknowledge to be most detrimental to health, and to be exactly adapted to the production, maintenance, and propagation of disease.

M. Dumont, from an examination of the histories of upwards of 2,000 blind persons, the term being here used in the popular sense, found that the cause of blindness was : smallpox, 262 ; ophthalmia, 566 ; injuries, 181 : amaurosis, 535 ; cataract, 66 ; amaurosis and cataract (glaucoma ?), 426 ; hydrophthalmia and various other causes, 20 ; total, 2,056. Bergmeister, in his Report on the Niederöstreichische-Landes Blinden Schule in Pürkersdorf, which contained 75 children (39 boys and 36 girls), states that the cause of the blindness was blennorrhœa in 12 cases = 20 per cent. ; measles in 12, congenital and hereditary blindness in 14, hydrocephalus in 7 ; other affections of the brain in 5, scarlet-fever in 6, injury in 2, Egyptian ophthalmia in 2, scrofulosis, rachitis, diphtheritis, each in 1 case, masern in 3, and there were 10 cases of doubtful origin. Of the 150 eyes in these 75 children, 95 were absolutely blind, and the remainder could distinguish between light and darkness. V. Millingen, in his

Report of his Private Dispensary at Constantinople, states that he observed 326 cases of blindness in the three years 1877, 1878, and 1879. The causes of the blindness were—Blennorrhæa-neonatorum, 4·3 per cent.; conj. gonorrhœica, 5·2 per cent.; blennorrhœa acuta, 3·4 per cent.; conj. diphtheritica crouposa, 3·6; keratitis ulcerosa, 20·7; iritis, 8·6; irido-choroiditis sympathetica, 3·7; atrophia nervi optici, 16·6; retinitis, 6·4; glaucoma, 8; retinitis albuminurica, 4·2; and the remainder from myopia, buphthalmia, microphthalmia, abscessus corneæ, keratitis bullosa, and sublatio retinæ.

Other authors, by whom the causes of blindness have been very carefully investigated, are—Schmidt Rimpler, Katz (1874), Stolte (1877), v. Zehender (1871), Seidelmann (1876), Emmert (1874), and above all by Magnus (1883) who has condensed and tabulated, as well as expressed in graphic form, the numerous observations and statistics of his predecessors. In the representation he has given of the causes of blindness in 2,528 cases, carefully examined by competent authorities, he distinguishes four classes: first, cases of congenital blindness; secondly, cases of blindness consequent on idiopathic diseases of the eyes; thirdly, blindness from injuries; and lastly, blindness occasioned by various diseases of the system at large. The particular diseases in each of the above classes, with their percentage proportion, is as follows:—

1. *In congenital blindness*, anophthalmos and microphthalmos, constituted 1·06 per cent.; megalophthalmos, 0·43; cataracta accreta congenita, 0·11; choroiditis congenita, 0·15; atrophia nervi optici, 0·75; retinitis pigmentosa, 0·75; congenital anomalies of the cornea, 0·07; congenital amaurosis from atrophy of the retina, 0·19; congenital tumours, 0·03; unnamed or indeterminate forms of disease, 0·23.

2. *Blindness from Idiopathic Diseases of the Eyes.*—Purulent ophthalmia of infants 10·87; trachoma and purulent ophthalmia of adults, 9·49; diphtheritic conjunctivitis, 0·35; diseases of the cornea, 8·06; iridochoroiditis and cyclitis, 8·86; choroiditis myopica, 0·94; various forms of choroiditis, 1·10; retinitis pigmentosa acquisita, 1·26; retinitis apoplectica, 0·11 per cent.; neuroretinitis, 0·79; sublatio retina (detachment of the retina), 4·74 per cent; glaucoma, 8·97; idiopathic atrophy of the optic nerve, 7·75; tumours of the eye and adjoining parts, 0·35; indeterminate causes, 3·36.

3. *Blindness from Injury.*—Direct injuries to the eye, 4·03: unsuccessful operations, 1·93; injuries of the head, 0·27; sympathetic ophthalmia following injury to one eye, 4·50.

4. *Blindness caused by Various Diseases.*—Syphilis, 0·47; blennorrhœa gonorrhœica, 0·91; scrofulosis, 0·03; disease of the membranes of the brain, iridochoroiditis associated with meningitis, 1·42; disease of the brain, causing atrophy of the optic nerve, 6·96; disease of the spinal cord, leading to atrophy of the optic nerve, 2·33; atrophy of the optic nerve or neuritis after hæmatemesis, 0·39; atrophy of the optic nerve, after vomiting, without discharge of blood, 0·079; atrophy of the optic nerve after hæmorrhoidal hæmorrhage, 0·039; atrophy of the optic nerve after erysipelas of the face, 0·079; atrophy of the optic nerve in insanity, 0·039; atrophy of the optic nerve in epilepsy, 0·158; atrophy of the optic nerve in dysentery, 0·029; retinitis nephritica, 0·198; cardiac disease, 0·039; pregnancy and confinement, 0·43; typhus, 0·94; measles, 0·63; scarlet fever, 0·51; small-pox, 2·21; exanthematous attacks, the nature of which is unknown, 0·23; amaurosis from intoxication, 0·03; diseases of the orbit, 0·03.

From a study of this table it will be seen that six forms of disease, the purulent ophthalmia of children, trachoma, diseases of the cornea, usually ulcerations, iridochoroiditis, glaucoma, and idiopathic atrophy of the optic nerve, constitute no less than 54 per cent. of all the causes of blindness, whilst the first two, which constitute together more than 20 per cent., may be regarded as almost, if not altogether, preventable; both arise from impurity and unwholesome hygienic conditions, and not only is the recognition of the disease at an early period in both instances easy, but the means of arresting their progress are always at hand, and can be applied with facility.

Congenital Blindness.—According to Magnus this constitutes 3·77 per cent. of all cases of blindness. It may be the result of various pathological conditions, the causes of which are not always very clearly defined. The most common conditions are either entire absence or imperfect development of the globe of the eye, which, together with congenital atrophy of the optic nerve, make up about 60 per cent. of all the cases of congenital blindness. Megalophthalmos forms 16 per cent., and the remaining 24 per cent. is made up of choroiditis and anomalies of the cornea.

Tumours of the Choroid and Indeterminate Conditions.—As might be expected from the development of the eye and adjoining parts, the globe may be defective or absent, whilst the lids, lacrymal organs, and conjunctiva may be fully formed. In many cases a cyst has been found in the orbit, and the writer has seen one case of bilateral anopthalmia in which a soft vascular mass, deeply pigmented, could be seen through the attenuated skin of the inferior lid of the left side, giving the impression that it was the displaced and partially developed choroid. Megalophthalmos, or enlargement and thinning of the coats of the eye, is probably due to intra-uterine processes of inflammation, and it has been observed as a concomitant of hydrocephalus. That heredity plays a part in the production of congenital blindness cannot be doubted after the careful consideration that Magnus has devoted to this subject. The principal constitutional diseases of the parents that lead to ophthalmic disease in the offspring are scrofulosis, tuberculosis, syphilis, and lepra. In all the inherited tendency to disease exhibits itself, particularly in low forms of inflammation of the cornea (*see* CORNEA, Inflammation of the), and the affection in the child may appear at any age between birth and fifteen or twenty years. From Magnus' observations it appear that about 23·5 per cent. of those who are the offspring of blind parents, are either born blind or have some defect of the eyes whilst the remainder have perfect vision. Dumont, however, who examined 1,168 cases of blind people in relation to this point, obtained evidence of heredity in only 68 cases, or about 5·8 per cent.; and, as in cases where the retina and its functions are at fault, there seems to be no great tendency for the same disease which is present in the parent to propagate itself to the child, but a distinct tendency to the transmission of some ocular defect.

Consanguinity.—To what extent consanguinity of the parents influences the ratio of ophthalmic disease and blindness in the children, has not been certainly determined, but there seems reason for believing that some affections—as, for example, retinitis pigmentosa—are especially liable to occur in the offspring of blood-relations. Thus, in Sämisch's clinique in the ophthalmoscopic hospital at Bonn, out of 60 cases of retinitis pigmentosa, 15 were the children of consanguineous marriages, which is undoubtedly a large proportion; and the ratio found by Leber was almost identical—18 cases in 66, the former representing 25 per cent., the latter 27 per cent. Mooren estimates it at 33 per cent., and Fienzal at 38 per cent. It may therefore be accepted as an approximation to the truth, that in about one-fourth of all cases of retinitis pigmentosa, the parents are blood-relations.

It will be seen from the above table that Magnus only admits about 11 per cent. of blindness to be due to purulent ophthalmia in Germany, and perhaps, if absolute loss of vision is considered, this may be true, but other authors, who probably use the term blindness in a less strict sense, give a far higher proportion. Thus Bourjot St. Hilaire believed that amongst the blind who presented themselves to him in the course of twenty years 27 per cent. were due to this cause. Appia found a proportion of 25 per cent. According to Claisse, amongst the 208 pupils in the Institute of Paris 95, or 46 per cent., had lost their vision from purulent ophthalmia. Reinhard, who drew his conclusions from an examination of twenty-two institutes for the blind, of which the greater number were in Germany, believed that 40 per cent. resulted from it. Lastly Daumas declared, at the Congress of Paris, that it was the cause of 69 per cent. of blindness.

The importance of the prevention of blindness, from a purely national and economic point of view, has been interestingly worked out by Magnus for Germany. He estimates the work done by each individual to be two marks per diem, or 600 marks per annum, the mark being about ten pence, and further they require for their maintenance one mark per diem; on the whole, therefore, the yearly loss to the state on each blind person is 765 marks. But in Prussia the number of blind persons is 22,677, of which, however, 2,875 have not attained their twentieth year. Putting these aside, the total annual loss to the State by the blind is about 20 million marks, or nearly a million sterling.

Preventibility.—The researches of Cohn seem to show that of 1,000 cases of blindness 238 were unavoidable, 438 were possibly preventible, and 329 were certainly preventible. It is of high importance, therefore, from every point of view, that a sound knowledge of the causation and treatment of the more important diseases of the eye leading to blindness should be taught in our hospitals and schools, made a prominent subject in all surgical and medical examinations, and in every way disseminated through the community. Much may undoubtedly be done to prevent blindness by recognising early such diseases as purulent ophthalmic trachoma, glaucoma, &c., and employing efficient treatment; and by adopting means to protect the eyes of those engaged in dangerous occupations.

Occupations suited for the Blind.—The occupations that *can* be followed by the blind are very various, about 300 being returned in the last census. Some of these are of course selected by the blind because they appear to be the best adapted to enable them to obtain a livelihood, such, for example, as basketmaking, brushmaking, bootmaking, matmaking, and music. Others show the dangers that beset certain trades and employments.

Asylums, &c.—Several of the larger cities in England contain institutions for the reception and education of the blind. Amongst the most noted of these are the blind asylums of London, Liverpool, Worcester, York, Norwich, Manchester, Bristol, Edinburgh, and Glasgow.

The first asylum for the blind in Christendom was founded by Saint Louis in 1251, and was intended to receive 300 of the poor blind of Paris, but no efforts were made for their education. In 1783, Valentin Haüy, having heard a blind pianist, Mademoiselle Paradis, who read music by means of pins, and who had learned geography by means of relief maps, conceived the happy idea of instructing other blind persons by the same method. An experiment on a boy proving satisfactory, he obtained funds from the Société Philanthropique to support twelve blind youths in a house in the Rue Notre Dame des Victoires, and the good example was soon followed in other countries.

Henry Power.

BLISTERS are subcuticular accumulations of fluid produced by an acute superficial inflammation of the skin, accompanied by effusion of serum and escape of white corpuscles beneath the cuticle, which is thereby raised up into a bleb. Blisters are met with in surgical practice as the result of burns and scalds, friction, and contusions or lacerations of deeper parts as in simple fractures, as well as from a variety of other causes; if due to inflammation alone, the effusion is serous or sero-purulent, but if there be also extravasation of blood into the limb, as in fractures, the effusion is often blood-stained.

Here we are more concerned with blisters produced by the surgeon with certain therapeutic objects, such as the relief of pain, or as a means of influencing more deeply seated inflammations, either in the way of checking them, or causing absorption of chronic inflammatory products. The most common substance used for this purpose is cantharides, either in the form of emplastrum cantharidis, liquor epispasticus, or charta epispastica. Before using either of them the skin should be well washed and dried; the length of time during which the plaster should be kept on the skin will vary, with the delicacy of it, from six to twelve hours. The liquor epispasticus is a solution of cantharidine in acetic acid and ether; it is a thick, greenish fluid, and only requires painting over the part; it is the most 'elegant' and generally useful preparation of cantharides. Blisters may be more rapidly produced by the application of chloroform in such a way as to prevent evaporation—usually on a piece of lint covered by a watch-glass, and held against the skin for a few minutes. Liquor ammoniæ fort. and the hot iron (temperature 120° F.) will produce the same effect, and the latter will do so very rapidly (10 seconds). The treatment of the blister when formed will depend on whether it is simply employed as a counter-irritant or to produce a continued discharge. In the former case the blister may be snipped here and there in dependent positions, and a pad of some antiseptic and absorbent wool applied; in the latter case the cuticle should be removed, and as soon as it can be borne the raw surface should be dressed with some irritating ointment; this is, however, a most painful procedure and one which is not often resorted to.

Bilton Pollard.

BLOOD-CYSTS. *See* Hæmatoma.

BLOODLESS METHOD OF OPERATING. *See* Esmarch's Bloodless Method.

BLOOD-LETTING, a method of treatment which, although somewhat limited in its scope in purely surgical practice, is of great service in certain cases.

Blood-letting is said to be *general* when blood is taken from a vein or artery so that the amount in the vascular system is materially diminished, as shown by diminution in the tension of the vessels; it is termed *local* when, by means of leeches, cupping, or scarification, blood is taken in smaller quantities, with a view to relieving limited congestion and vascular tension. It may be safely said that in these two methods the surgeon possesses the means of treating, in a powerful and beneficial manner, those acute inflammations and engorgements of certain important organs and serous membranes associated with hard pulse, great pain and distress, occurring from injury in persons of healthy constitutions. A point of particular importance is the aptitude possessed by blood-letting for alleviating pain and distress of the kind mentioned, as it is upon this ground, rather than upon its power as a direct antiphlogistic, that its value in surgery depends. The greater the pain and distress, the greater are the indications for the treatment.

In *general* bleeding this is well shown in cases of fractured ribs, with wound of the lung, in which the pain and dyspnœa are intense, the relief afforded by blood-letting by venesection in a full stream until the pulse is affected being most marked. An equally good result may be obtained in the same way in fractured ribs with high temperature, acute pain, and hard pulse, without lung-injury. In meningitis produced by injury, it is necessary to speak less positively; at the same time, if the disease is very acute, and the treatment adopted early, there is little doubt that, in a subject previously healthy, venesection may be practised with advantage; every care, however, should be taken to distinguish between true acute traumatic meningitis and tubercular meningitis, following on injury, in which bleeding is inadmissible.

In *local* blood-letting the same point may be illustrated. Most surgeons are familiar with the relief afforded by the application of a few leeches (from four to six) over the most painful spot on the belly in a case of acute traumatic peritonitis without visceral lesion; the same result may be obtained by similar means in nearly all cases of acute traumatic synovitis, especially of the knee-joint. So great is the relief in many such instances that the first calm sleep, ushering in recovery, follows immediately. To cases like those mentioned, blood-letting, in surgical practice proper, will for the most part be limited, and even in these the treatment, to be useful, must be applied early, when the symptoms are increasing in acuteness or remain stationary; if the climax has been reached, and the disease has assumed in the least degree the low type, the time for bleeding is gone by. One condition the surgeon may have to deal with, in which, independently of inflammation, the indication for bleeding is obvious, viz. apnœa, with great engorgement of the veins about the neck following attempts at strangulation, for it is reasonable to suppose that the removal of a few ounces of blood by opening the right external jugular vein, if done early enough, may perhaps relieve an overloaded heart so much as to enable it to resume its normal action.

Caution.—Blood-letting should not be practised without due consideration, since its effect is more than momentary, and may be followed by much depression; nor should the operator, in general bleeding, start with a fixed purpose of removing a given number of ounces of blood; but let the pulse be most carefully watched, and it will surely indicate by its diminished tension when enough has been drawn. Loss of blood is badly borne by infants, the very old, the prematurely aged, the feeble and cachectic; if, therefore, it should be necessary to take blood from such as these, let not a drop more than is really necessary be removed.

For operations for General Blood-letting, see ARTERIOTOMY; VENESECTION. *For operations for Local Blood-letting, see* CUPPING; LEECHES; SCARIFICATION.

WILLIAM H. BENNETT.

BOILS consist in a circumscribed inflammation of the skin and subjacent connective tissue, accompanied by fibrinous exudation, and usually followed by sloughing of the central portion of the parts involved, and expulsion of the slough through a small hole upon the surface.

The *causes* of boils are various and somewhat indefinite. Sometimes boils are almost epidemic, and they are generally more frequent in the spring and autumn. They are apt to attack the plethoric, as well as those who are debilitated by lactation, diabetes, or zymotic disease. Sudden changes of diet and mode of life, such as the patients of hydropathic establishments have to undergo, are apt to induce them. The same effect is observed in young servants, and in youths training for athletic sports, where the changed conditions are accompanied by a more liberal supply of meat. The affection has also been noticed to attack with great violence those who have eaten the flesh of diseased animals. They are not infrequent among medical students who breathe the vitiated air of dissecting and post-mortem rooms. Where there is already a constitutional predisposition, the exact site is often determined by some local irritation, such as the friction of the nates in rowing, the pressure of certain articles of dress, the application of a poultice or plaster. They may also be set up by the absorption of putrid matters through the skin, and from this cause those engaged in pathological work frequently suffer from boils upon the back of the hands or wrists.

Symptoms and Course.—Boils may be single or multiple, and they may occur successively in different parts of the body. An itching spot appears usually at the opening of a hair-follicle, and soon develops into a small red lump. This is frequently surmounted by a vesicle or pustule, which bursts or dries up. As it grows, the swelling becomes of a bluntly conical shape, tender, painful, and of a bright red colour. At first it is hard, but it soon begins to soften, and the pain becomes of a more throbbing character. In a few days an opening forms at the summit, and some pus is discharged. At the bottom of the opening is seen a yellowish mass, consisting of a slough of fibrous tissue infiltrated with lymph. This—the so-called *core*—after a few hours escapes through the opening, and leaves a flask-shaped cavity, which contracts and fills with granulations. In a day or two it heals, and a small scar is left upon the skin. Another variety, called the *blind* boil, is less elevated and more diffused. It is slow to discharge itself, or it may remain as a firm indolent swelling for several weeks, and then undergo resolution without any suppuration.

There is usually but little constitutional disturbance in those affected with boils. A slight chilliness, with a transient feeling of malaise and irritability, may accompany the onset, but afterwards the only trouble is that caused by the local pain. When, however, they occur in already debilitated patients, the symptoms may partake of a hectic or even typhoid character; and cases are on record in which the disease has proved fatal by the supervention of pyæmia.

The inflammation attacks more especially the sebaceous follicles of the hair-bulbs. Boils, therefore, are not found in parts in which these structures are absent, such as the palms and soles. When they occur in the follicles of the eyelashes, they are called *styes.* They may also attack the ceruminous glands of the ear, and sometimes they affect the sweat-glands, especially those of the axilla.

Diagnosis.—The red, indurated, and tender base, which is large in proportion to the small pustule at the apex, will distinguish boils from impetigo, ecthyma, or the blebs which sometimes follow poisoned wounds of the skin. Carbuncle, a closely allied affection, is easy to recognise by its larger size, more flattened surface, and the numerous apertures which lead down to the central slough. Malignant pustules are usually confined to those who have been exposed to the specific contagion of that disease, and the absence of pain, together with the peculiar character of the eschar, will be sufficient to lead to their identification. The gummata of syphilitic or tubercular patients occasionally resemble boils, but they may generally be known by their attacking chiefly the subcutaneous tissues, and by their bursting with a larger external opening.

Treatment.—The patient should take a plain nutritious diet, with only a moderate quantity of animal food. Unless there is much debility, there is no advantage in the use of alcoholic stimulants. He may take sulphate of quinine three times a day, in 2-grain doses, with a grain of sulphate of iron, and from 5 to 10 drops of dilute sulphuric acid, accompanied by ʒss. of sulphate of magnesia if the bowels be not well opened. The administration of as large quantities of quinine as can be borne without cinchonism has sometimes proved beneficial. Sulphide of calcium, in $\frac{1}{6}$-grain doses every hour or two, has been recommended; and some cases improve rapidly under the administration of yeast in doses of a tablespoonful three times a day, half an hour before meals. A change of air often succeeds where other remedies have failed.

For local treatment the boil may be covered upon its first appearance with a thick layer of collodion, or it may be touched with nitrate of silver. The extract of belladonna alone, or in combination with an equal quantity of glycerine, is also a good application in the early stage. Later on, considerable relief is afforded by a linseed meal poultice, but as there is some risk of irritating the adjacent skin, and setting up fresh boils by this remedy, it is well to sprinkle it with olive oil, or the dilute solution of the subacetate of lead, before putting it on the boil. When these applications are inconvenient, the elevation may be protected by a covering of plaster spread on soft leather, in which a hole should first be punched at a point corresponding to the apex of the boil. It is only in cases in which the pus is very slow in reaching the surface that an incision is required; and then it should only be a deep vertical puncture in the centre of the boil, made with a narrow double-edged knife.

N. Davies-Colley.

BONE, Diseases of.—The various forms of disease which attack the human skeleton are the same in kind as those which are seen in the soft parts, modified of course by the anatomical and physical peculiarities of the bony structure. The slowness with which the morbid changes are effected is one of its striking peculiarities. Consequently amongst diseases of bone we find some of the most chronic disorders from which the human body is capable of suffering. If, as in some of the acute inflammatory affections, rapidity of action should ensue, the death of the part involved is the usual termination. Although so slow in exhibiting pathological change, bone is nevertheless capable of the most perfect repair. Although slowly, it produces granulations as readily as any other tissue of the body, and, provided its vascular connections have not been completely annihilated, the bone is reproduced almost in its original form. Its rigid and inelastic structure is no doubt the reason for the frequency of necrosis, and the inability of the veins of the medullary canal to collapse from the same cause, coupled with the absence of valves, is undoubtedly the origin of the pyæmia and septicæmia so frequently seen in inflammatory affections of bone, in the days when decomposition of the discharges was not prevented by suitable antiseptic precautions.

The diagnosis of bone-disease, i.e. of bone being the part affected in any given swelling, must first engage our attention. The freedom of other, and especially the superficial structures, is the most important negative evidence. In infiltrating and inflammatory swellings, however, the soft tissues are sometimes very rapidly involved, and then we have to rely upon other symptoms for the diagnosis. Generally we are able to say that the bone itself feels enlarged, or that the tumour or swelling is fixed and attached to bone; and if the superficial structures are engaged, we are often able to obtain evidence of pain and tenderness having been felt before the external parts exhibited any swelling. In most of the diseases of bone, however, the first and most important symptom is an enlargement which is quite clearly deep-seated. The patient usually complains of a dull, aching pain, which is especially troublesome at night on getting warm in bed, and keeps him awake for many hours. The pain is scarcely ever acute, and is sometimes the only symptom of which complaint is made. A sense of increased weight is also occasionally felt.

The differential diagnosis between the various affections of bone has next to be considered. The patient's history may often be of great service, first, as to the possibility of the disease being due to accidental causes; but even here there may be exceptions of considerable importance, e.g. acute diffuse periostitis often has a history of some slight and trivial accident preceding the onset of the symptoms of inflammation. So much is this the case that some surgeons look for and expect to find a history of injury in almost all cases of diffuse inflammation of periosteum. Again, in sarcoma of bone it is not uncommon to have a history of injury of considerable severity, and, within a very short time of the accident, a tumour is discovered in the part injured. This form of tumour has lately been dignified with the name of 'acute traumatic malignancy.'

It is well to bear in mind that ostitis, periostitis, and osteomyelitis, are so intimately united, both in their pathology and in their clinical symptoms, as to be occasionally confounded with one another. Almost every inflammation of bone, of whatever kind, is at times spoken of as periostitis, whereas the periosteum has, in most of such cases, only been secondarily involved, ostitis or osteomyelitis being the primary condition. The cases in which the periosteum is primarily or principally involved are, however, sufficiently distinct; and there should be no difficulty, at any rate, in distinguishing the cases of periostitis when this membrane is alone affected. *See* Periostitis. Acute inflammations of the bone, periosteum, or medulla, taken as a group, are readily separated from the other diseases of bone by the suddenness of the attack and the acuteness of the process of inflammation. The history also of a previous illness, such as one of the specific fevers, or the occurrence of a slight and trivial accident in a young subject, would be additional evidence in favour of this view of the case.

The chronic diseases may present a little more difficulty. The patient can scarcely say when the affection began. He may have suffered pain at night for some months; or when first his attention was directed to the part of which he complains, the state of things may have been in the same condition as at the time when he asks your advice. In the one case a history of long-preceding pain would point to chronic inflammation of bone; and in the other, the presence of an enlargement which, when first noticed, was of such a size as to lead him to seek advice for that alone, would indicate a new growth such as an exostosis, or possibly a sarcoma of bone. But an examination will probably at once clear up the difficulty. The first point necessary to ascertain is the presence or absence of inflammation. This will be decided on ordinary grounds which we need not here discuss. The acute inflammatory affections have been already mentioned, and will be further described, each in detail, under their appropriate titles. The symptoms of subacute or chronic inflammation might perchance be mistaken for those of a sarcoma of bone. They are both infiltrating in character: both may feel hot and inflamed to the hand: both may be either endosteal or periosteal. The question naturally arises, Does the swelling fluctuate? is it solid or fluid? If it be dense and solid throughout, and occupy nearly the whole shaft of a long bone which seems to be uniformly enlarged throughout its whole length, there can be no difficulty in ascribing it to chronic ostitis. But if the swelling occupy one end of a long bone, and if that should be the lower end of femur or head of tibia, the case may present greater difficulties. Clearly, if fluctuation be detected, and the fluid seem quite close to the surface, the case will probably be one of abscess, and if the bone is much enlarged all round that part of its circumference, the pus will, in all probability, be due to inflammation of the cancellous tissue. More commonly, however, the pus has not thus made its way to the surface, and its presence is only detected by the excessive tenderness which is exhibited on pressure at one spot. For further information, *see* Abscess of Bone.

New growth affecting the same part may also give rise to an elastic feeling very closely resembling fluctuation. But the tumour generally presents greater irregularity of outline, and varies considerably in its elasticity and resistance to pressure in different parts. In the periosteal sarcoma, the growth will probably be situated on one side, whilst in the central or endosteal form of tumour the whole outline of the bone, at the part affected, will be lost: and, in addition, such unmistakable evidence of its nature as 'egg-shell crackling' and pulsation may possibly be obtained. A sarcoma affecting the centre of the shaft of a long bone is at first often fusiform in shape, but rapidly assumes much larger dimensions than any chronic inflammation would produce; and, if endosteal, it is not infrequently indicated by spontaneous fracture. *See* Tumours of Bone.

An exostosis requires very little explanation. It is generally a pedunculated growth of small size, attached by preference to the bone in the neighbourhood of epiphyseal lines, and starting into existence about the age of puberty. On examination it is not uncommon to find more than one, or even a considerable number, in different parts of the body. Further details will be found under Exostosis.

The osseous deformities of rickets and congenital syphilis will be found described in the articles on those diseases. Softening of bone and spontaneous fractures will be found described under Osteomalacia and Fragilitas Ossium. The curvatures of the long bones, especially those of the lower extremities, which occur in old age, and are attended with a large development of osteoporotic new bone, both in the long bones which are deformed and in the skull, will be found described under Ostitis Deformans. If a sinus should exist when the case first comes under observation, the surgeon is referred for information to the articles on Caries and Necrosis.

The constitutional condition of the patient may throw some light upon the nature of the disease, and should be carefully considered in relation to the various affections which have been named. High fever may be expected in cases of acute diffuse periostitis and osteomyelitis. If of recent origin and considerable intensity, and the local symptoms bear out this conclusion, the information gained by the thermometer will give great precision to the diagnosis. Hectic fever also may be observed in these cases when the disease is of some duration; and its presence or absence may aid the surgeon considerably in forming an opinion as to the prognosis. But the general condition of the patient, his tolerance of the constitutional and local disturbance which he is undergoing, and the probable duration of the disease, should have due weight in estimating the chances of recovery.

Of all the constitutional diseases, syphilis is the most important to recognise, and should always be looked for in subacute and chronic cases. The periosteal nodes generally appear during the early stages of this disease, so that one may expect to find some other evidence of syphilis, either in the throat, on the skin, or in the glands. This is of importance, as it will lead the surgeon to place the patient under the influence of mercury, after having relieved the painful nodes by iodide of potassium. In enlarged and thickened bone, such as osteosclerosis, in gummatous periostitis, and in intractable ulceration of bone, sometimes called syphilitic caries, a history of the disease should, if possible, be obtained, as it enables the surgeon to treat the constitutional affection with greater confidence. But too much reliance must not be placed on the absence of such a history, for experience teaches us that many cases must be classed as syphilitic on account of their exact similarity both in the course they run, the prognosis that must be given, and in the treatment that is essential for their cure, although the history of the disease be decidedly deficient in many of its most salient features. Many cases of ostitis that were formerly looked upon as strumous, are now regarded as due to congenital syphilis. They occur generally in the middle of the shaft of a long bone, such as the tibia, about the age of puberty, and are exceedingly chronic. Confirmation of the diagnosis should be looked for in the eyes, teeth, and physiognomy of the patient, and if possible the brothers and sisters should be examined in the same way, as in suspected cases of congenital syphilis. The epiphysitis that occurs somewhat earlier in the history of such patients might possibly be confounded with rickets, but this has received full attention in the article on diseases of the epiphyses.

Struma and tubercle must also receive their share of attention in the chronic, slowly suppurating, diseases of bone, such as caries and chronic abscess. It is unnecessary to point out here the way in which this is to be done. The history and physical examination may indicate pretty clearly that the patient is predisposed to these affections. H. H. Clutton.

BONE-GRAFTING. *See* Grafting.

BONE-SETTING.—The term 'bone-setting' was first applied to the proceedings of certain irregular practitioners, who flourished chiefly—so far as this country is concerned—in the North of England, and who were accustomed to treat by rough manipulation, and frequently to cure, joints which had been left in a disabled condition either by disease or by injury. Their manipulation was commonly attended by the production of sound, which the operators would explain to be the noise made by a displaced bone in the act of returning to its socket; and they were, as a rule, sufficiently ignorant to believe this explanation themselves, as well as sufficiently earnest to succeed in imposing it upon their patients. Hence, when a joint which had been under medical treatment, and remained crippled in spite of it, was cured by the handling of a 'bone-setter,' he would say, and the patient and his neighbours would believe, that the doctor had overlooked a dislocation. Of late years the whole subject has been carefully studied by surgeons, instead of being, as formerly, pooh-poohed by them. It has been found that in a very large number of cases of injury, and in some cases of disease, the rest which commonly forms part of the treatment, produces an injurious effect, as well as a beneficial one; and that it leads to the formation of adhesions, either within or around the affected joint, by which its mobility is impaired. The formation of such adhesions may sometimes be prevented by early recourse to passive, or even active, motion; but, if once formed, they can only be got rid of by tearing. In the course of the necessary manipulation they yield with a distinct sound, for which the original bone-setter was always on the watch; and the old term has been retained, as affording a convenient expression for the modern practice. The bone-setting of the surgeon differs from that of the quack, to the extent that the former understands the pathology of the cases to which it is applied, and confines its application to those in which it is needed and is calculated to be useful.

It will be convenient to consider first the conditions which call for the employment of bone-setting, and these are all forms of partial ankylosis. The cause of the partial ankylosis may be either disease or injury of the affected joint, or of some parts contiguous to it; the effects of such disease or injury being aggravated by prolonged abstention from movement, and the ankylosis itself not coming into prominence until the endeavour to move the joint is resumed.

The pathology of these cases is to some extent conjectural, since they rarely become the subjects of post-mortem examination; but there can be no doubt that conjecture and analogy are sufficient to afford correct notions of the conditions which commonly exist.

The occurrence of inflammatory (i.e. rheumatic or pyæmic) mischief in a joint, an actual injury, such as a sprain, befalling it, or the fracture of the shaft of one of the bones entering into its formation, are, all of them, conditions which have been customarily treated by enforced rest and restraining apparatus. The rest itself, and the pressure of the apparatus, combine to promote the exudation of more or less plastic fluid from the blood-vessels; an exudation which will, of course, be still further promoted, and be rendered more highly plastic, when the joint-structures are themselves affected. The exudation may occur within or around the cavity of the joint, within or around the sheaths of the neighbouring tendons, or it may be more widely diffused among surrounding structures. The tendency is to consolidate and contract, to glue together the adjacent folds of synovial membranes, to unite tendons to the sheaths in which they should move freely, to permeate and condense inter-muscular and superficial connective tissue, to compress blood-vessels, and generally to arrest movement and to diminish functional and nutritive activity.

The impediments to movement are strictly mechanical; and hence, when these impediments produce traction on parts which are not normally adherent, the traction is apt to be painful, and may be followed by increased swelling, by tenderness, or by other signs of increased local inflammation.

The *symptoms* are, that a joint which has been subjected to any of the incidents above mentioned, which has been inflamed, or injured, or long restrained from movement by reason of a neighbouring fracture, does not recover its mobility. It can usually be moved to some extent, but its movements are limited, and any attempt to transgress these limits is attended by pain, and is often followed by fresh evidence of active mischief. It is frequently possible to discover by pressure some spot which is acutely tender. The joint is usually somewhat swollen, the skin covering it more or less congested, glossy, or tumid; and the muscles of the limb are wasted in a degree corresponding with the length of time during which they have been inactive.

The *treatment* must be considered under two heads; first, with reference to the cure of the above-described conditions; secondly, with reference to the means by which their occurrence may be prevented.

For the cure there is only one available method, namely, rupture by manipulation of all adhesions which impede movement. Experience has abundantly proved that, although the mere extension of the adhesions gives much pain, and sometimes excites fresh inflammation, the complete rupture of them by a single movement is not more painful in the first instance, and is never followed by any subsequent trouble. Unless in very slight cases, a patient for whom it is proposed to break down adhesions should always be placed fully under the influence of an anæsthetic. The question of pain is only a secondary one, and the majority of people would have sufficient fortitude to bear the operation; but it is highly important to overcome the instinctive resistance of opposing muscles; and it is almost equally so to allow the surgeon to proceed with deliberation and care, feeling his way as he goes, and not desisting until the complete range of mobility is restored. It must be remembered that a certain knack is required in breaking adhesions, and that different joints require somewhat different handling, the details of which it would be difficult to convey without the aid of illustrations. In the last four or five years much has been written on the subject, and, among others, the writer has given the necessary illustrations, and full verbal descriptions of them, in his work on 'Bone-setting (so-called).'

When adhesions have been broken, the most important part of the after-treatment is that the joint should be taken into use immediately. Supposing the knee to have been affected, the patient should be made to bend it freely, and to put down the foot and walk on the same day, and every day afterwards until the cure is complete. Any return to splints or bandages, or to enforced rest, will certainly be followed by reunion of the adhesions, and by renewed incapacity.

Under the influence of functional use, the swelling around the joints will gradually disappear, the muscles will recover their tone and vigour, and the old troubles will be forgotten; although, of course, time will be required for the full completion of reparative changes. But, if the operation of breaking the adhesions is followed by inaction, all that is gained at the time will be lost, and the treatment will have to be repeated before a cure will be obtained. It is hardly necessary to say that, especially in cases of long standing, recovery may be much promoted, after the adhesions are broken, by the diligent use of passive movement, by frictions, and by the more skilled forms of friction which are known as shampooing or massage. These, however, must be auxiliary to the movements effected by the patient, and must not be expected to supersede or to replace them.

It is not unnatural that surgeons, who have seen the recurrence of inflammation which is apt to be produced by the slight extension of joint-adhesions, should fear to permit free movement immediately after adhesions are broken. Reflection will show that the two conditions have nothing in common. The inflammation following slight extension was due to the drag of the stretched adhesions on neighbouring parts; but, by the complete rupture of the adhesions, all possibility of dragging is taken away. In considering the means by which partial ankylosis may be prevented, it is needful for the surgeon to clear his mind of one of the ancient traditions of his art, and to realise the fact that 'rest,' although sometimes a necessary part of treatment, is at best a necessary evil, not to be resorted to without necessity, and not to be continued a day after it can be dispensed with.

In some cases of fracture, enforced rest of the neighbouring joints is imperatively necessary; but, even then, the surgeon should never forget the consequences which this rest may produce, and should be on the watch to employ passive movement at the earliest possible time.

In cases of another class, in which rest is commonly employed, it is from the first not only unnecessary, but always and actively injurious. Sprains of every description, and accidental ruptures of muscular fibres during effort, should be treated by strapping and bandaging, and the moderate use of the affected limb should not be interfered with.

When this method is pursued, a short time will suffice for complete recovery from an injury which, if treated by the old plan of rest and fomentations, would mean imprisonment to a bed or sofa for weeks, probably followed by permanent diminution of strength and usefulness.

WHARTON HOOD.

BOUGIES—so called because wax tapers (bougies) were at first generally, and are still occasionally, used for the purpose—are supple instruments for passing along the gullet, rectum, or urethra, to widen those passages when narrowed. They vary in length and size, to suit the different canals they are to traverse, being about 2 feet long for the gullet, 8 or 9 inches for the rectum, and 13 inches for the urethra. Their thickness varies also greatly, and is measured in this country by scales which vary with different makers. The French scale, which is generally adopted on the Continent and in America, and is coming into usage here, enlarges by equal increments, each size being 1 millimetre larger than the preceding one. Those used for the urethra are made in three forms, of which there are several varieties, and range from 1 millimetre to 40 millimetres in circumference. The 'English' or 'gum elastic' bougie, of tawny brown colour, is made of a seamless tube of silk woven like a stocking. Several coats of copal varnish are laid on until a fine smooth surface is obtained. This bougie is cylindrical, of the same thickness throughout, rigid when cold, but pliant when warmed to the temperature of the body. If kept bent for several weeks it takes a 'set' which it is slow to lose. If well made it is tough and durable even when rigid, but if badly made the English bougie is apt to snap if bent suddenly.

The French bougie is more flexible than the English; it is similarly woven of silk, but the shape is better adapted to pass along the urethra. It is covered with black varnish. The full width of the bougie reaches to about the lower third; from thence to the point the bougie tapers gradually, and is very pliant near the tip. When the tip is a little bulbous the bougie is called 'olivary,' but this form is also made to taper to a moderately fine point without a bulb. In a well-shaped olivary bougie the 'swell' of the tip is just sufficient to remove all sharpness from it, and the tapering end itself is so supple that it bends easily if the tip catches in an obstruction. This pliancy diverts the point and lets it slip past the obstacle. The tapering bougie is less durable than the English 'gum elastic' one, especially if really made in France, for the imported ones are not so well varnished or so tough and smooth as those of English manufacture. But the genuine French article is the better shaped: the English imitation often does not taper rapidly enough; the point is stiff, and cannot yield at once to an obstruction. Again, the olive of the tip is apt to be too large, and form a real boss as thick or thicker than the widest part of the bougie. The flexibility of the tapering bougie has been modified by the introduction of leaden stylets, themselves tapered to a fine point that penetrates to the tip of the bougie. Instead of a wire stylet, the bougie may be filled with fine shot. By either plan the instrument may be bent to any curve, and will keep the curve while it is being passed along the passage. Bullet bougies (*bougies à boule*) are used for exploring canals. They consist of a slender tubular stem, to which the necessary stiffness is given by inserting a leaden wire into it. The stem ends in an egg-shaped bulb. In these bougies the stem remains of the same thickness, while the bullets range in circumference from 8 millimetres to 40 millimetres. The stem may be usefully marked at each inch from the bullet with a ring, the ring at the fifth inch in urethral bougies being broader than the rest, to serve as a landmark from which to count.

For passing through strictures too narrow for woven bougies, others of whalebone, catgut, and silkworm gut are used. Whalebone is troublesome from its rigidity, but that can be lessened by steeping the bougie in boiling water. Catgut is apt to get rough, and, after soaking for a short time in the mucus of the urethra, it becomes inconveniently supple. Silkworm gut is very strong, very fine, and not affected by urine or water. It is therefore preferable where bougies of moderate length and great tenuity are required. Bougies made of a new material, 'celluloid,' have been recently patented. They are non-absorbent, very smooth, and pliant when heated, but resume their rigidity too quickly to be generally useful for bougies. When cold the celluloid is sometimes very brittle. These qualities render this material of limited use for bougies, but for catheters for tying in the urethra celluloid is well fitted. It remains perfectly unaffected, however long it is worn, and unirritating, because at the temperature of the body it yields to the curves of the passage in which it lies. *See* CATHETERS. BERKELEY HILL.

BOUTONNIÈRE, the Operation of.—This term has been applied to an incision made in the perineum in the treatment of urethral strictures, which has been known by many appellations. As the name '*boutonnière*' suggests, the incision is a small one made in the mesial line of the perineum, and resembles a button-hole. The operation is an ancient one, and has been practised in various ways both in England and France for centuries. In modern surgery there are three modifications of it, or, rather, it is practised to serve three purposes:—1st. To expose the anterior end of the stricture of the urethra through which an instrument cannot be passed by way of the meatus, in order to divide the stricture from before backwards. 2nd. Also in cases of impassable stricture, to open the urethra behind the stricture, either to relieve retention of urine, or to give the bladder and stricture rest from the irritation caused by the straining necessary to force urine along a very narrow passage. The stricture, of course, would be dealt with by subsequent operation. 3rd. When disease of the bladder is present, for which digital exploration of the mucous surface is required, or when it is necessary to maintain free drainage of the bladder and the presence of an instrument cannot be borne.

1. The first variety of the operation—to get at the anterior orifice of, and thereby pass along the stricture a guide upon which the knife may divide the fibrous tissue that causes the contraction—is best performed by the method known as Wheelhouse's. The patient being anæsthetised and in the position for lithotomy, the operator passes along the urethra, from the meatus to the stricture, a straight steel staff 4 or 5 millimetres in circumference, 11 inches long, and grooved on one side. The beak is turned into a blunt knob or hook towards the side opposite the groove. With the groove directed towards the surface the staff is pressed forwards in the perineum until it can be readily felt from without. While the staff is held steady by an assistant, a vertical cut is made in the mesial line by the surgeon, large enough to allow the beak of the staff being thrust through the wound. The staff is then turned, that its knob may catch in the anterior end of the incision, which is tightened and fixed by the assistant, who pulls it steadily upward. The operator continues his incision in the mesial line backwards towards or over the stricture for about one inch, dividing the urethra freely opposite the anterior end of the stricture. By a hooked forceps applied on either side, the margins of the incision are drawn apart, and the interior of the urethra is exposed opposite the mouth of the stricture. This opening is carefully sought for, and, when found, a grooved director, with a fine tapering point, is insinuated through the stricture to the bladder. The point of the knife being then entered in the groove of the director, its edge is carried backwards till the stricture is thoroughly divided. The knife is laid aside, and a small tapering gorget, with a beak that will run along the groove of the director, is passed to the bladder. When the gorget has reached the bladder the director is withdrawn, and a flexible catheter, introduced by the meatus into the anterior part, is guided along the deeper part of the urethra by the gorget. The catheter being fixed in the bladder, the gorget is withdrawn, and the operation is completed.

2. By the second method—known as 'Cock's operation,' from its having been frequently practised and its value demonstrated by the eminent surgeon of that name—the urethra is reached in its membranous portion behind the stricture, at a point where it is usually dilated and more easily recognised than in the healthy state. Like the first form of boutonnière just described, this operation is adopted only when an instrument cannot be guided along the urethra to the bladder. The part of the urethra

attacked in the operation is that between the bulb and the prostate. The finger, with its tip just within the margin of the anus, feels the anterior or lower surface of the prostate, and informs the operator of the posterior limit of the membranous portion of the urethra. The central point of the perineum, being just behind the bulb of the corpus spongiosum, gives, for the purposes of the operation, the anterior limit. The knife, held with its cutting edge forward, is entered in the *raphé* of the perineum three-fourths of an inch in front of the anus, and a cut made through the integuments about half an inch long and half an inch deep. The tip of the finger inserted into the wound enters the small conical interval between the anterior wall of the rectum and the membranous part of the urethra. In cases of retention of urine the urethra, dilated at this point, can often be distinguished, and projects in a condition which facilitates the remainder of the operation. The operator, using the finger as a guide, pushes the knife cautiously upwards and backwards into the urethra. The gush of urine that escapes proves the urethra to have been opened, and the finger may then enter it and pass to the neck of the bladder, serving as a guide for introducing a catheter. This completes the operation.

3. In the third variety the operation is extremely simple. A curved lithotomy staff, having the groove on the centre of the convexity, not on the left side, is passed to the bladder and held steadily while the surgeon, pushing the knife on to the staff just behind the bulb, cuts for one inch or three-quarters of an inch towards the anus. This affords an aperture large enough for the finger to enter and pass into the bladder and search the whole of the interior, and ascertain the position, size, and shape of tumours or other affections of that organ. Berkeley Hill.

BOW-LEG may make its appearance before a child's feet have been put to the ground, in which case it is simply an exaggeration of the natural curve of the tibia under the influence of muscular contraction. Or it may be the effect of that peculiar habit which the rickety child possesses of folding its legs across each other and sitting upon them tailor-wise. Often this condition of leg is associated with an exaggeration of the natural outward bowing of the femur, in which circumstances genu extrorsum (q.v.) is the result. Sometimes one leg is bandy whilst the other is in-kneed. This is caused by the mother or nurse carrying a soft-boned child always upon the same arm, whilst with the other she clasps the child's legs across the front of her body. Thus, if she carry the child always upon her left arm, the right knee will become valgous, whilst the tibia of the other leg will become moulded against the valgous knee, and consequently bandy.

Treatment should be begun as soon as the existence of the deformity is recognised. If the child be badly nourished or rickety, he should be carefully tended as regards feeding and clothing; warm stockings or woollen gaiters should be advised, with the view of keeping up an even circulation in the legs. If, when the child is being carried or wheeled out in the open air, the feet and legs become chilled, the nutrition of the bones must necessarily be seriously interfered with. Frictions in the direction of the venous and lymphatic return should be employed morning and evening after the warm bath, and if the patient be flabby, weakly, or ill-nourished, not only his legs but his entire body may be rubbed with cod-liver oil. A large proportion of those with bent legs have been brought up upon the bottle, and many of them reared upon condensed milk or a farinaceous diet; fresh milk, eggs, and meat will be wanted, but no tea, beer, or wine. If the treatment thus briefly sketched out be adopted, and the child be taken entirely off its feet, a slow but steady improvement will set in; but if the deformity be already considerable, it will be well to adopt accessory measures. Thus, a light wooden splint, padded on each side, may be fixed between the limbs, and the legs be bandaged to it. The splint should be long enough to reach some inches below the level of the feet, so that the child may be unable to stand, for, whatever be the treatment adopted, no weight must be transmitted through the leg-bones. To apply splints of wood or iron, and then allow the child to walk about, is manifestly wrong.

Children do not fret when they are made to keep off their feet, nor does their health suffer from the enforced rest. If only one leg be bowed, it should be bandaged to a long inside splint, so as to insure rest. The improved condition of the bone is obtained more by rest being insured, than by the mechanical effect of the bandaging. Some years ago the writer had under his care a little girl with extremely marked bowing of both legs; one leg he treated by forcible straightening under chloroform, the other he let alone. The child was taken completely off her feet, and at the end of a year the bandiness had almost entirely disappeared from both legs; the rest which had been necessary for the limb which had been forcibly straightened, had induced an equal improvement in the other. It may be well to note that the use of a Martin's bandage with the splint is apt to cause cellulitis, ulcerations, or even sloughing; and that in forcible straightening of the limb care is required, lest the epiphysial cartilages be torn through. Osteotomy for the bandy legs of little children must be very rarely necessary. EDMUND OWEN.

BOZEMAN'S OPERATION is an operation for ruptured female perineum, in which metal plates and wires are employed. *See* PERINEUM, Rupture of the.

BRACHIAL ARTERY, The, commences at the lower border of the teres major, and passes downwards and forwards along the inner bicipital groove until it reaches its bifurcation, one inch below the elbow.

In front are—the skin: the superficial fascia with cutaneous nerves therein: the basilic vein: the median basilic vein at the elbow: the deep fascia: the bicipital fascia at the elbow: the median nerve, crossing it half-way down the arm. Behind it are—the long and inner heads of the triceps, the insertion of the coraco-brachialis, the brachialis anticus, and the musculo-spiral nerve. Internally it has the ulnar nerve at its upper part, the median below. Externally the coraco-brachialis muscle, the external cutaneous nerve, and the outer head of the median at the upper part, the biceps below.

Ligation.—(1) In the upper third the steps of the operation are as for ligature of the axillary artery in the third stage, the basilic vein appearing in the wound in place of the axillary. (2) In the middle of the arm, place the patient on his back, with the arm abducted at a right angle and rotated outward. Make an incision in the line of the artery two inches long. Cut through the cutaneous structures, expose the inner edge of the biceps, and then draw the muscle gently outwards, when the median nerve will be seen lying on the artery. Detach the nerve and pull it inwards or outwards, the former the better; open the sheath, avoid the venæ comites, and pass the needle from without inwards, having the arm slightly flexed at the time. (3) In the lower third—i.e. at the bend of the elbow—the artery lies between the tendon of the biceps, externally, and the pronator radii teres internally. It has the median basilic vein and the bicipital fascia in front, and the median nerve to the inner side. With the arm abducted and rotated outwards, make an incision $1\frac{1}{2}$ inches long over the course of the artery, and immediately ($\frac{1}{8}$th of an inch) internal to the tendon of the biceps. Pull the median basilic vein and the internal cutaneous nerve inwards: cut through the bicipital fascia, when the artery is found surrounded by venæ comites, having the biceps one-third of an inch to its outer side, the median nerve one-third of an inch to its inner side, and the brachialis anticus behind. JAMES CANTLIE.

BRACHYMETROPIA. *See* MYOPIA.

BRAIN, Abscess of the. *See* ENCEPHALITIS.

BRAIN, Compression of the.—Compression arises from pressure on the brain. It may be brought about in many ways, such as by depressed bone, intracranial hæmorrhage, accumulation of inflammatory products, tumours, syphilitic and tubercular deposits, cerebrospinal fluid in undue quantity, &c. Intracranial hæmorrhage is by far the most common cause of compression; especially is this the case if idiopathic apoplexy, which is generally central, be included along with that occurring from traumatism, which is usually peripheral. Paralysis is its most definite indication.

Diagnosis.—The symptoms are dependent upon the amount of the pressure, and the rapidity and rate at which it occurs. Small effusions of blood, and slight osseous depressions, may take place without giving rise to any distinct symptoms. It is believed that blood may be slowly effused upon the surface of the brain without giving rise to any definite indications of its presence. Rapid extravasation, on the other hand, produces symptoms of marked compression. In a typical case of compression, the following are the general symptoms:—The patient is comatose, breathing is slow and laboured, often stertorous, and in some cases this is accompanied by a peculiar puffing arising from complete facial paralysis; there is retention of urine, which, if unrelieved, ends in incontinence from overflow. The pupils may either be contracted or dilated; they are often unequal, and they are usually fixed, not responding to light. The surface of the body, though it be at first cool, soon becomes hot, and often it is bathed in perspiration.

Though these are the symptoms recognised as typical of compression, it must not be understood that they are present in all cases. In localised compression the paralysis is only partial, and corresponds to the affected region. There may be paralysis of one side of the body, with loss of consciousness; or of one limb, or only of the muscles supplied by certain nerves, without loss of consciousness. There may also be mental confusion or delirium. One pupil alone may be affected, the other remaining quite normal.

The order of the symptoms is important, helping to differentiate the various causes of compression. When depressed bone is the cause, the symptoms follow immediately after the accident. When due to intracranial hæmorrhage, especially when this takes place outside the membranes, there is generally an interval before the symptoms set in. When inflammatory effusion takes place, the symptoms are gradually developed, and are ushered in by a series of phenomena, such as increased temperature and general febrile disturbance. When pus forms between the dura mater and the bone, as the result of traumatism, it takes place one or more weeks after the injury. In tumours the symptoms are generally very slowly developed. When the effusion of blood is so great as to exercise pressure on the brain generally, there will be in most cases no symptoms indicating the locality of the effusion. But when sufficient pressure affects a part of the brain only, localising symptoms may be looked for.

INTRACRANIAL EFFUSIONS OF BLOOD may take place outside the dura mater; into the cavity of the arachnoid; into the pia mater; and into the substance of the brain, or one of its ventricles. When the out-pouring of blood into any of these positions arises from traumatic causes, the symptoms occur slowly, and an interval of time generally elapses between the accident and the occurrence of the symptoms, though this may not be evident when insensibility ensues from concussion, or when compression is induced by depressed fracture. By reference to the symptoms alone, it is difficult and frequently impossible to differentiate between blood poured out on the exterior of the dura mater and on the surface of the brain, especially when the amount of the effusion is great. But when there is an external injury of limited extent, the probability is that the blood is superficial. When there is evidence of contusion or laceration of the cerebral substance, extravasation of blood into the brain-tissue will have occurred at that point.

Extravasation on the *outside of the dura mater* may take place from the rupture of minute vessels which pass between the skull and that membrane; or from large vessels which lie in the osseous grooves in the interior of the skull. When it arises from the former, the extravasation is not extensive, and seldom causes marked symptoms; if from the latter, the amount of blood effused is great, and separates the dura mater from the skull, often to a considerable extent; at the same time it causes, by its pressure, marked depression of the cerebral substance. The vessel most frequently found ruptured from traumatic causes is the middle meningeal, or one of its branches. In fractures of the middle fossa, this vessel may be ruptured at any part of its course from the foramen spinosum to the anterior inferior angle of the parietal. The blood may, however, come from one of the sinuses, the lateral being the one most frequently ruptured. So that the parietal region is the one in which blood is most frequently effused between the dura mater and the skull. It has to be borne in mind that considerable effusions of blood may occur without giving rise to marked symptoms, if the effusion takes place slowly.

Traumatic effusion of blood frequently occurs *in the cavity of the arachnoid.* Its existence in this particular position cannot be diagnosed from that on the outside of the dura mater. But if the surgeon, led by the symptoms of localisation, has trephined on account of blood causing pressure on the brain, and finds none between the dura mater and the skull, he will be able to discern, by the dark blue appearance of this membrane, the presence of blood in the arachnoid. Blood effused into this region undergoes changes of a somewhat peculiar kind. The clot generally becomes attached to the parietal layer of the arachnoid, and later it becomes vascular, by penetration of the loops of capillaries. It ultimately may be converted into fibrous, and it is said even into cartilaginous, structures. Frequently these are cystic in form, and may be either attached to one of the layers of the arachnoid membrane, or remain free in its cavity.

Extravasations of blood *beneath the arachnoid* spread all over the brain-surface, and are not confined to the area in which they originate. They are generally associated with lacerations of brain-tissue. Unless very extensive, they do not readily lead to distinct manifestations of brain-symptoms.

Effusions of blood *into the brain* are common accompaniments of laceration and contusion of cerebral substance, and the symptoms are apoplectic in their character. Compression of the anterior part of the brain is much less serious to life than when it implicates the middle or posterior lobes. The symptoms of compression of the anterior lobes are very slow in appearing, and are frequently of such a slight character as not to be observable, unless on very close attention. Compression of any part of the motor area is generally easily recognised.

The prognosis of compression, due to extravasated blood, depends greatly on the seat of the pressure, and also as to whether there has been pouring out of blood into the brain-tissue, as, in the latter case, there is frequently irreparable destruction of the parts into which the blood has been poured. When effusion of blood takes place into the central parts of the brain, pons varolii, or medulla oblongata, or if there be great effusion into the ventricles, the condition is much more serious than when it is superficial, or exists between the skull and the dura mater.

Treatment of compression.—The cause of the compression ought, if possible, to be removed. The treatment of compression arising from depressed fracture and inflammatory action within the skull, is fully dealt with under SKULL, Fracture of the; ENCEPHALITIS; suffice it to say here, that the bone ought to be elevated in the former, while exit to inflammatory effusion ought to be afforded in the latter. Cerebral tumours, which have been localised and which are situated in any accessible region of the brain, especially in the cortex, should be removed. Regarding effusions of blood, they present the most readily removable of all the causes of compression, more especially as the majority of them, arising from traumatism, are found on the periphery of the intracranial structures; and also, as they are free from the complication of inflammatory products (at least soon after the occurrence), which so often accompany other lesions occasioning compression. In trephining for the relief of pressure caused by blood, a large disc of bone should be elevated. If the blood be situated immediately beneath the skull, it will present itself whenever the bone has been withdrawn. The surgeon should then examine the aperture carefully, passing the probe between the dura mater and the skull, and by this means removing adherent blood-clots.

If the blood be in the cavity of the arachnoid, it will be recognised by the dark blue colour shown through the superficial membranes. The dura mater should then be freely opened, and the blood withdrawn. In some instances blood will present itself as a dark body in the pia mater or in the periphery of the brain-substance. This should be taken away. After all the effused blood has been removed from the interior of the skull as far as practicable, the bone should be replaced, an exit for drainage being kept patent. The scalp should then be brought carefully together, and the wound dressed antiseptically. If these operations are done aseptically, there is no fear of the procedure itself increasing the danger of the case. The statistics of such operations in the writer's practice are very favourable.

The patient ought to be kept quietly at rest in bed, the head shaven, the bowels freely acted on, and the diet restricted to milk or beef-tea. *See* HEAD-INJURIES, Diagnosis of. WILLIAM MACEWEN.

BRAIN, Concussion of the.—Concussion is a form of shock. Shock may arise from either mental or physical impressions. Physical impressions may produce shock, either directly by acting on the brain through the skull, or indirectly by the depressing influences conveyed to the central nervous system by the nerves of the part of the body which has been injured. In either case, a functional paralysis results. Peripheral shock arises from sudden, extensive, and severe injuries to any part of the body, but it is most prone to follow injuries of the abdominal viscera, the genitals, the bones, and the joints. Central shock or concussion originates from violent blows or falls, which produce shaking of the whole brain. These may act directly on the head, or they may do so through the trunk, the person falling from a height on the feet or buttocks.

Concussion may therefore be defined as that form of shock which arises from direct commotion of the cerebral substance, resulting in functional paralysis. In some post-mortem examinations of cases of this description, no cerebral structural lesions of any kind have been discovered, even with the use of the microscope. It is true that in many such cases the spine has not been examined. In others, minute hæmorrhagic extravasations have been found in the pia mater or in the substance of the brain. When lacerations existed, it is probable that these would have indicated their presence during life, by distinctive symptoms, had time been afforded for their development, the concussion meantime having masked the other symptoms. The morbid physiology of this cerebral loss of function is obscure. Various theories have been advanced; the most popular is the assumption of a molecular disturbance of the protoplasm of the brain-tissue. Uncomplicated cases (of concussion) are comparatively seldom seen by hospital surgeons. The majority of cases of concussion are associated with some head lesion, which forms a complication, such as fracture of the skull, laceration, contusion, and compression of the brain. In many instances the concussion is at first paramount, but, as it begins to pass off, the indications of the other lesions manifest themselves. In other instances, compression, when localised, is apparent at an early period, along with a certain amount of concussion.

The *symptoms* of concussion are generally described as occurring in four stages—collapse, rallying, reaction, and gradual convalescence. The stage of collapse may be indicated by very varied symptoms. In slight cases there may only be vertigo and mental confusion, with faintness. In others, the patient is insensible, like a person in a deep faint—stunned. The skin is cold and pallid; the features blanched and contracted; the respirations superficial and shallow, and sometimes sighing; the pulse feeble or imperceptible; the reflex actions abolished; but there is no true paralysis. In this stage of insensibility, the pupils are always dilated. When they are otherwise, it indicates the existence of some complication. The period of rallying is generally ushered in by vomiting, and sometimes by an epileptiform attack. The reflex actions can now be excited, the pallor leaves the face, the pulse becomes stronger, the respirations more distinct, consciousness returns, and the whole condition of the patient begins to improve. This period of rallying may occur a few minutes after the injury, or the patient may remain in a collapsed condition for days prior to the rallying.

Reaction follows, with increased temperature, hot skin, flushed face, quick bounding pulse, and scanty urine. In severe cases the patient may die comatose, with symptoms of inflammation of the brain. In slight cases the period of reaction may be almost imperceptible, and the patient may pass gradually into convalescence. It is during the period of reaction that many lesions of the brain, previously masked, show themselves, such as localised compression, contusion, or laceration; and it is in these cases that the reactionary period is most likely to be marked by inflammatory symptoms. In uncomplicated cases of concussion the period of reaction is comparatively short, but when encephalitis arises it may last for weeks. The convalescent stage may be short or protracted, according to the condition established during the period of reaction. During convalescence many complain of languor, headache, and inability to work.

In uncomplicated cases of concussion, a fatal issue may occur during the period of collapse; but when reaction is fairly established comparatively few succumb, unless inflammation of the brain supervene. Though the majority of cases of simple concussion recover perfectly, in some there remains impairment of mental powers and of sensory functions, and these defects are at times permanent.

Treatment.—During the period of collapse, the patient ought to be enveloped in warm blankets, and have hot bottles or bags applied to the feet. A rectal injection of warm water, or diluted beef-tea, has often the desired effect of promoting reaction. Stimulants ought seldom to be employed, and when they are, they should be used with the greatest circumspection. The patient ought to be kept in bed in a quiet room, and his stay in bed ought not to be less than a fortnight, in the mildest cases. His diet ought to consist of little else than milk, until the convalescence has been fully developed. During the reactionary period, the head should be shaven, the room darkened, and the bowels acted on by mild purges. *See* HEAD-INJURIES, Diagnosis of. WILLIAM MACEWEN.

BRAIN, Hernia of the.—When a portion of brain-matter protrudes through an opening in the skull and its membranes, while its base is still continuous with the brain, a *hernia cerebri* has been established. In certain injuries brain-matter escapes, and is found on the outside of the skull, quite detached, and separated from the general mass of the brain. Such an escape of brain-matter ought not to be included under the title of hernia of the brain, though it is very commonly regarded as one.

Cerebral herniæ are divided into two classes—true and false. The former indicates a protrusion, containing the characteristic structures of cerebral substance, as may be verified under the microscope; the latter consisting of inflammatory new formation, often of masses of granulation-cells, the products of inflammatory action in the brain. Occasionally also these false herniæ consist of red cells, a little fibrin, and a few white corpuscles.

Hernia cerebri may be produced at the moment of injury. The writer has seen such cases. In one a portion of the frontal bone was driven into the brain; the hollow which was left by the depressed bone was filled to the level of the scalp by a pulsating mass of brain-matter, which had escaped at the moment of the accident. More frequently, however, the escape of brain-matter at the time of the accident takes place in the form of detached and separated pieces, which do not constitute herniæ. All cerebral herniæ and cerebral protrusions, occurring at the time of the injury, retain the white appearance of brain-matter, which they exhibit on being washed from the blood so apt to surround them. Herniæ of the brain usually occur some time after injury, and then are always mixed with inflammatory exudation in varying proportions; commonly the exudation forms the greater bulk. They rarely appear before the second or third day after the opening of the skull, and their appearance may be greatly delayed, weeks elapsing in some cases. While cerebral protrusions, occurring at the moment of injury, retain their natural appearance, those which take place some days afterwards present a greyish-red colour, and have a fungating aspect.

Herniæ generally occur on the upper and lateral aspects of the brain; they seldom protrude from the base. The frontal and parietal regions are their most common site. They are rarely or never found in the occipital region. There are cases on record where considerable quantities of brain-matter have been protruded through the base of the frontal and cribriform plate of the ethmoid, and have escaped through the nose. The writer has seen two cases where brain-matter was seen issuing from the ear, in fracture of the petrous bone. In one it was in small and detached pieces, in the other there was a considerable hernial protrusion of a fungating form presenting at the external orifice of the ear.

Formerly hernia cerebri was looked upon as the necessary sequence of wounds and injuries which penetrated the skull and brain-membranes, exposing the brain. Under altered conditions of treatment it rarely follows such wounds, and only arises when excessive inflammatory action of the brain-tissue has been set up. It is also erroneous to suppose that such inflammatory conditions can only arise as a consequence of wounds. It is true that the herniæ cannot exist without an aperture, but when there has been idiopathic inflammatory action of an excessive kind, the moment the skull is opened, the inflammatory products protrude and form the hernia cerebri.

Regarding prognosis, these herniæ may be divided into two kinds,. primary and secondary. The primary herniæ are such as occur as the immediate results of an accident, when fresh healthy brain-matter has been protruded. In such instances the hernia, though it must be regarded as a serious lesion, does not often lead to a fatal issue. Quite a number of such cases have recovered. The good results obtainable depend greatly upon the treatment. The secondary herniæ are the sequents of inflammatory action in the brain, and are therefore to be regarded in a much more serious light. The majority of cases in which they occur prove fatal, not so much from the herniæ themselves as from the fact that they are mere indications of the extent of the inflammatory action in the interior of the brain. Still recovery does take place, in young people especially.

Treatment.—In all cases, scrupulous antiseptic precautions, with due regard to the prevention of irritation, ought to be adopted. Such measures are the most reliable prophylactics when the brain is exposed, and the best treatment when the inflammatory action is established. This is especially the case with herniæ, as they are very prone to undergo decomposition, and to give rise to a very fœtid odour. 1–1000 bichloride solution may be used as a wash, and the part may be covered with sublimated wood wool.

William Macewen.

BRASDOR'S OPERATION. — The term commonly used by French writers for the operation of applying a distal ligature. Wardrop was, however, the first to perform the operation. *See* Aneurism.

BREAST, Diseases of the.—Abnormalities of Secretion.—1. *Appearance of Milk unconnected with Pregnancy* is very rare. It has occurred as the result of allowing an infant to suck at the nipple.

2. *Agalactea or total Absence of Milk after Child-birth* is also rare, except in cases of premature delivery. Should there be delay in the appearance of the secretion, hot fomentations may be applied and the child put to the breast. By perseverance

in these means the secretion will usually be induced by the second day at latest. Deficient secretion is common in feeble and anæmic women. In such cases it is better to wean the child at once, as the imperfect supply is evidence that the mother is not fit to suckle.

3. *Galactorrhœa or Excessive Secretion of Milk.*—This may occur at an early period of lactation, and consist of a constant dribbling of milk from the swollen and distended breasts, or it may consist merely in a prolonged secretion in spite of efforts to arrest it by weaning the child. The former condition is an individual peculiarity, and its causes are doubtful; the latter is sometimes the result of prolonged suckling, or of uterine disease.

Treatment.—Galactorrhœa can usually be arrested by the external application of a paint composed of equal parts of glycerine and extract of belladonna, and by the internal administration of saline purgatives. In those cases which occur at an early period of lactation, iodide of potassium has been known to arrest the secretion.

HYPERTROPHY OF THE BREAST.—True hypertrophy is a rare disease. It consists simply in an enormous over-growth of the mammary tissue.

Causes.—It has been attributed to menstrual irregularity, excessive sexual excitement, blows, &c. It commences usually about puberty. Of 26 cases collected by Labarraque, only 5 were over twenty-six years of age. In some few cases the enlargement has been an exaggeration of the normal evolution of the breast in pregnancy.

Symptoms.—The chief symptom is the steady and often rapid enlargement, affecting both mammæ in most cases. There is little pain, the chief inconvenience arising from the size of the breasts. This may be enormous, the breasts sometimes resting on the thighs when the patient is in a sitting posture. Cases have been recorded in which the patient was unable to bear the weight of the mammæ when in the erect position, and their pressure has been such as to interfere with respiration when lying down. The enlarged glands are usually somewhat hard and knotty, but not tender. In those exceptional cases which occur during pregnancy, there may be galactorrhœa; in others there is no secretion of milk. The general health suffers when the enlargement is considerable, the patient becoming anæmic; amenorrhœa is commonly present. After reaching a certain size the growth ceases.

Diagnosis.—The only disease resembling hypertrophy is a large cysto-sarcoma. The affection of both breasts, the central position of the nipple, and the absence of cysts serve easily to distinguish hypertrophy.

Treatment.—Various preparations of iodine have been used internally and externally without effect; they may, however, be tried. The external application of belladonna might relieve pain. Pressure has been tried without success. If the encumbrance becomes great, the only efficient treatment is removal of the enlarged breasts.

NEURALGIA OF THE BREAST, OR MASTODYNIA.—The term neuralgia of the breast is properly applied to those cases in which pain is the only symptom, and in which no tumour or inflammatory induration is present. It is a rare affection.

Causes.—It is met with during the period of functional activity of the reproductive organs, and in all classes of society. It usually occurs in hysterical women, and is often associated with some uterine affection, with anæmia and habitual constipation. It has been attributed to blows or to the pressure of badly fitting stays.

Symptoms.—The pain is severe and paroxysmal, radiating from the breast to the neck, shoulder, or arm. It may be distinctly periodic in character, and is usually worse during menstruation. It is usually referred to the whole breast and not to any localised spot. There may be slight fulness of the affected gland.

Treatment.—Any uterine disturbance must be relieved, if possible. Constipation must be relieved by purgatives; anæmia by iron, animal food, and change of air to a bracing climate. Locally, the most useful treatment is the application of strips of belladonna plaster spread on leather in such a way as to support the breast and draw it slightly inwards. Opium in any form must be forbidden.

INFLAMMATORY AFFECTIONS OF THE BREAST.—*Acute Mastitis, Acute Parenchymatous Inflammation, Mammary Abscess, Milk Abscess.*—Acute inflammation of the breast may occur in both sexes and at all ages, but it is rare in adults except in connection with lactation. A form of inflammation occurs in new-born infants, and is termed mastitis neonatorum, and a similar condition is sometimes met with at puberty.

Causes.—The inflammation most commonly appears during the first month after delivery, and is usually supposed to be due to retention of milk from obstruction of a duct, but the evidence of this is not very good. In many cases it is preceded by a sore nipple, and possibly extension of the inflammation into the deeper structures may then be the true cause. Blows and exposure to cold during lactation are occasional causes. Mammary abscess is most common in women who nurse their own children, and in primiparæ. It is not a common consequence of enforced arrest of the secretion, as after the death of the child. The pus of an acute mammary abscess always contains micrococci, but how they get there, and what part they play in the causation of puerperal mastitis, are points not definitely determined.

Symptoms.—The first symptom is often some swelling and engorgement; there is pain, aggravated when the child is put to the breast. There is a feeling of weight, relieved by supporting the gland with a bandage or handkerchief. On examining the breast an ill-defined hardness is felt, most commonly towards the lower and outer side. Sometimes several such patches may be present. There is acute tenderness on pressure, and some œdema of the subcutaneous tissue. The thermometer shows some elevation of temperature. As the inflammation progresses, the thermometer rises to 102° F. or 103° F. or even higher, and there may be a rigor. The œdema increases over the indurated part, the skin reddens and fluctuation becomes distinct. If left unrelieved, the abscess may reach such a size as to contain many ounces of pus before it bursts. Both breasts are rarely affected. Under proper treatment the inflammation may subside without reaching the stage of suppuration, in fact this probably occurs in about half the cases.

Pathological Anatomy.—The observations on these cases are very few, and have been chiefly made in women dying of puerperal septicæmia or pyæmia. The ordinary signs of inflammation are found, the chief exudation being at first around the acini, but this does not prove that the source of iritation arises from within them, for similar appearances can be produced in animals by passing a seton through the gland. It is due merely to the vessels and lymphatics being most abundant in that situation.

Treatment. — This must at first be directed to the prevention of suppuration. The child must be removed from the affected breast, and the milk gently drawn with a breast pump. If the patient be weak the infant must be weaned. The arm must be fixed to the side to secure rest. The breast must be supported by a handkerchief or bandage passing over the opposite shoulder, and the patient should be kept as much as possible in the recumbent position. The part should then be painted with extract of belladonna and glycerine (equal parts) and hot fomentations constantly applied. Leeches are of little or no use and cold applications only do harm. Linseed-meal poultices are too heavy. If it be intended to arrest the secretion of milk, the bowels must be kept gently relaxed by means of saline purgatives.

If, in spite of this treatment, pus forms, when should it be let out? Some surgeons recommend opening as late as possible, or even leaving the abscess to burst. There seems no reason why the patient's pain and fever should thus be needlessly prolonged. To cut deeply into so vascular an organ as the actively secreting mamma in search of doubtful pus would certainly be wrong; but as soon as its presence is proved by the aspirator, or by fluctuation, it should be let out. The abscess should be opened with efficient antiseptic precautions (*see* Antiseptic Surgery), and no cases better repay the little extra trouble involved in so doing. The incision must be so placed as to radiate from the nipple in order to avoid damage to the ducts. It need not be larger than is necessary to admit a drainage-tube of $\frac{3}{8}$ inch in diameter, or even smaller if the abscess be not of great size. Great care must be taken, however, to ensure efficient drainage.

Consequences of Puerperal Mastitis.—Inflammation, which has stopped short of suppuration, leaves more or less induration of the inflamed area, lasting for many months or even permanently. This condition may very closely resemble scirrhous cancer. *See* Breast, Tumours of the, Diagnosis of. When an abscess has existed the induration is usually more marked, but the nature of the case is made more evident by the scar. These indurations sometimes become the starting-point of cancer. In the cases of carcinoma of the breast collected by Gross the disease arose in this way in 8·21 per cent.

Fistulous tracks or sinuses occasionally remain after a mammary abscess has been opened. These discharge a thin fluid not unlike human milk, but a true lacteal fistula is a very rare occurrence. Most commonly the sinus leads to a cavity surrounded by indurated tissue and imperfectly drained. A true lacteal fistula will not heal till the secretion of milk is arrested. A sinus leading to a cavity is best treated by enlarging the orifice. If the discharges are decomposing, the cavity should be scraped with a sharp spoon, and then cleaned with a small piece of sponge held in a pair of forceps and soaked in a solution of chloride of zinc (40 gr. to f℥j). This treatment is almost invariably followed by rapid healing.

Mastitis Neonatorum.—In new-born children of both sexes the rudimentary mamma becomes slightly swollen about the third or fourth day of life, and if at this time it be gently squeezed a small quantity of alkaline fluid containing colostrum corpuscles can be squeezed from it. The swelling and secretion reach their maximum on the tenth day and then gradually subside.

Acute submammary abscess.—A submammary abscess is a collection of pus in the areolar tissue between the gland and the pectoralis major. It is met with, almost exclusively, in puerperal women, and is, most probably, due to suppuration commencing in a deep lobule of the gland.

Symptoms.—The earliest symptoms are deep-seated pain, increased when the child is at the breast, tenderness, and febrile disturbance. As soon as the inflammation extends to the submammary areolar tissue, the symptoms are intensified. The breast becomes tense and full, and is pushed forwards bodily. There is severe pain, greatly increased by moving the arm. The febrile disturbance in this stage is very great. At first no fluctuation can be detected, but, after a time, redness and œdema, followed by distinct evidence of fluid, appear at some point of the circumference of the gland, most commonly the outer and lower border. Sometimes pus may point in more than one place. If left to itself the abscess bursts, sometimes at several points in the circumference of the gland, leaving sinuses which are very slow to heal.

Diagnosis.—The diagnosis is made by observing that the pain is increased by movements of the arm, or by moving the gland over the pectoralis major. The general prominence of the swollen breast is another important sign.

Treatment.—In the early stages the same treatment must be adopted as in ordinary puerperal mastitis, in the hope of preventing suppuration. The arm must, at the same time, be firmly fixed by bandages to the side. As soon as it is evident that pus is present, a free opening must be made in the place at which it is pointing. The incision should be parallel to the border of the gland and not directed towards the nipple, otherwise the gland is needlessly wounded. A large drainage-tube should be inserted, and some efficient antiseptic dressing applied. The troublesome sinuses which not uncommonly form are due, in most cases, to insufficient drainage and the presence of a cavity beneath the mamma containing decomposing pus. Under these circumstances, the orifices of the sinuses must be enlarged, so as to admit the finger. The cavity and sinuses are then to be scraped with a sharp spoon and cleaned by means of a sponge soaked in a solution of chloride of zinc (40 gr. to f℥j.). Drainage-tubes may then be inserted and gradually withdrawn as the cavity closes, some antiseptic dressing being applied. A counter-opening must be made at the most dependent part if necessary.

CHRONIC INFLAMMATORY AFFECTIONS OF THE BREAST.—*Chronic lobular interstitial mastitis* of one, or of several lobules, of the breast, is not uncommon in women past middle life, and is occasionally met with at an earlier period. The *causes* of this affection are very uncertain. It seems, in some cases, to be associated with uterine disease, but this is by no means constant. It is most common at the period of the cessation of menstruation, but is also occasionally met with in young women. Women who have borne children are more liable to it.

Symptoms.—The patient's attention is usually attracted to the breast by some pain and tenderness. Sometimes this is very severe, neuralgic in character, and aggravated at the menstrual period. On examining the breast an indurated nodule will be felt, varying in size from a filbert to a walnut, but seldom reaching the latter size. The patient often states that there is some increase of size at the menstrual period. The nodule does not slip about in the gland, but is evidently part of the gland itself. The outline of the indurated lobule is ill-defined and it gives a sensation rather of leathery toughness than stony hardness. Small projections of great hardness are sometimes to be felt in it. These are small and very tense cysts. When the nodule is of considerable size and very superficial, the skin may dimple slightly over it when pinched up between the finger and thumb. After the affected lobule has reached a certain size the disease tends to become stationary, and often the pain subsides and the patient suffers no further trouble. Several such lobules are occasionally met with in one breast, and both glands are not infrequently affected.

Pathology.—The indurated lobule is dense and leathery in consistence, opaque white in colour, and can often be seen by the naked eye to be composed chiefly of bundles of fibrous tissue. Small cysts, seldom as large as a pea, tensely distended with fluid, either clear, or turbid and brownish in colour, are often scattered through it. The outlines of the diseased lobule are not clearly defined. It differs from scirrhous cancer in its leathery consistence and its flatness on section, and in not yielding a milky juice on scraping. Microscopic examination shows that it is a genuine interstitial inflammation. In the advancing margin the interacinous connective tissue is infiltrated with small round cells. In the more advanced stages these are found to have developed into dense fibrous tissue, the process being accompanied by contraction, as in the analogous conditions of cirrhosis of the liver or kidney. By this contraction the ducts are pressed on, and, as at the same time there is some slight excess of secretion in the acini, small retention cysts are formed.

Prognosis.—The disease tends to become stationary after reaching a certain point. It is possible that occasionally the indurated lobule may be the starting-point of a cancer, but this is certainly rare.

Diagnosis.—Chronic lobular interstitial mastitis may be mistaken for a chronic abscess, an adeno-fibroma, a cyst or scirrhous cancer. From an adeno-fibroma it is distinguished by its want of mobility in the gland and its ill-defined outline; from a cyst by its want of elasticity and its irregular outline; from a chronic abscess by its not arising in connection with pregnancy or lactation, and by the absence of œdema over it. In cases of doubt a grooved needle may be inserted, which will at once show the true nature of a chronic abscess or cyst. From scirrhous cancer the diagnosis is often so difficult that it can only be made by means of an incision into the nodule. *See* BREAST, Tumours of the, Diagnosis of.

Treatment.—The treatment of this disease is not very satisfactory. Blistering, tincture of iodine, and other counter-irritants have usually little effect. The inunction of mercurial ointment is often recommended, but is of doubtful utility. The pain is best relieved by the application of a belladonna plaster. Should there be any concomitant uterine disorder, it must be attended to. If the patient is anæmic, the pain is usually more severe, and relief is then obtained by the administration of iron. Sir James Paget speaks of the following mixture as, in some cases, promoting absorption of the induration: ℞ Liq. potassæ fʒj., Pot. iodidi gr. ij. To be taken three times a day, after meals, in not less than f℥iv. of any simple liquid. If everything else fails, and the patient's mind is much disturbed by the fear of cancer, a single lobule may be excised.

Chronic Abscess of the Breast. Encysted Abscess.—This somewhat rare affection derives its interest from the close resemblance that it bears to scirrhous cancer.

Causes.—Chronic encysted abscess almost invariably arises in connection with pregnancy, and very frequently with miscarriage or abortion. Gross states that he has seen it in scrofulous subjects independent of impregnation.

Symptoms.—The symptoms closely resemble those of chronic lobular interstitial mastitis. There is a hard lump in the breast, seldom reaching the size of a walnut; it is tender, but not markedly so, and may be the seat of some pain. Its outline is ill-defined; it evidently implicates the mammary tissue and cannot be separated from it. There is some œdema of the tissues covering it, and if the skin be pinched up there is usually slight dimpling. In this state it may remain for many months without marked change. If it reaches any considerable size there may be a sense of elasticity in its central part. Finally it may become definitely adherent to the skin. There may be slight enlargement of the nearest axillary gland.

Pathology.—If a chronic abscess be examined by a section carried through it, it is found to be situated in a lobule of the mamma. In the centre is a small cavity lined with granulation-tissue containing thick pus. The tissue surrounding this cavity is composed of dense fibroid tissue, in the midst of which remains of the glandular structure may be recognised.

Diagnosis.—From an adeno-fibroma it is distinguished by its ill-defined outline and its implication of the glandular tissue. The presence of œdema, the dimpling of the skin, and its ill-defined outline will usually serve to distinguish it from a cyst. The distinction from chronic interstitial inflammation without suppuration is very difficult, but the œdema may serve to show its real nature. From scirrhous cancer it may be almost indistinguishable, except by puncture or incision. *See* BREAST, Tumours of the, Diagnosis of. Many breasts have been removed needlessly for want of taking the precaution of cutting into a doubtful induration before proceeding to the operation.

Treatment.—The only treatment is to open the cavity. Healing will be promoted by scraping it with a sharp spoon.

TUBERCLE OF THE BREAST.—The mamma is very rarely the seat of tubercle. Grey granulations have never been observed in it. Billroth records a case in which numerous caseous nodules were found in the breast of a young woman who died of pulmonary tuberculosis. Duret and Dubar have described some cases in which chronic abscesses with curdy contents slowly formed in the breast, but the evidence that they were tubercular is not perfect.

Syphilitic Diseases of the Breast.—Primary sores and mucous tubercles on the nipple are occasionally met with. Chronic diffuse induration of the gland and the formation of gummata in it have also been described, but there can be no doubt that these conditions are exceedingly rare. Ambrosoli describes cases of diffuse induration which disappeared under iodide of potassium. Gummata have been described by various authors, as forming painless swellings commencing in the mammary tissue and gradually increasing till they reach the surface. Softening then takes place, and finally the skin gives way, exposing the characteristic slough, resembling wet wash-leather in appearance. This separates slowly, leaving a deep excavated ulcer. Further observations, however, are required before syphilitic diseases of the breast can be described with any certainty.

Tumours of the Breast.—*Cysts.*—Excluding cysts in solid tumours, three forms are met with in the breast:—1. Retention Cysts; 2. Serous Cysts; and, 3. Hydatid Cysts.

1. *Retention Cysts.*—These are formed by dilatation of the acini or ducts of the gland. The conditions essential to their formation are, obstruction to a duct and some excess of secretion from the part where the cyst is formed. Galactocele, which properly belongs to the class of retention cysts, has been already described with errors of secretion. Excluding galactocele the following varieties of retention cyst are met with:—

(*a*) *Involution Cysts.*—These are formed in the indurated and atrophied breasts of old women. They are usually numerous, and scattered throughout different parts of the gland. They seldom reach any considerable size, and are of little importance.

(*b*) Cysts, as already stated, are common in the indurated part *in chronic lobular interstitial mastitis.* They seldom reach any size.

(*c*) Retention cysts arising independently of these conditions are usually termed *glandular* or *duct cysts.* They may be single or multiple. They may be seated deeply in the gland or superficially near the nipple. They are composed of a fibrous vascular wall lined with epithelium, which is either cubical or inclining towards columnar in form. Their contents are thick, sometimes resembling mucus in consistence, turbid, brownish, or yellowish in colour, and frequently stained with recent blood. Intracystic growths are not uncommon. They are composed of delicate vascular papillæ, covered with epithelium springing up from the walls of the cyst and sometimes almost filling its cavity. It is possible that in some cases this condition may end in the peculiar form of cancer termed villous or duct cancer. See *Cancer of the Breast*, below. The obstruction of the duct leading to the cavity is in many cases not complete, and the contents can be made to flow from the nipple by firm pressure on the cyst. The *causes* of these cysts are uncertain; they are most common in women under forty, and are often attributed to a blow.

2. *Serous Cysts.*—These are supposed to be formed, as in other parts of the body, by dilatation of the lymph-spaces of the connective tissue. The walls are composed of fibrous tissue, lined internally by an imperfect layer of flattened endothelial cells. Their contents are usually clear serous fluid rich in albumen, but they may be altered by an admixture of blood. Serous cysts are usually single and often multilocular, but may be multiple. They may reach a considerable size, containing some ounces of fluid. Nothing is definitely known as to their cause.

3. *Hydatid Cysts of the Breast* are very rare in this country. When they occur they present no special peculiarities. *See* Hydatids.

Symptoms of Cysts of the Breast.—A cyst of the breast forms a slowly-growing, rounded, tense, or elastic tumour, sometimes smooth, often lobulated, on the surface. Its outline is in some cases tolerably clearly defined; in others it is obscured by indurated glandular tissue around it. It is attached to the gland, and not movable independently of the mammary tissue. It is free from pain and tenderness.

Treatment.—Glandular or serous cysts, if single, may be cured by making an opening large enough to admit a small sponge moistened with chloride of zinc (gr. 40 to f℥j). With this the inside may be thoroughly scrubbed. A drainage-tube is then to be inserted, and an antiseptic dressing of some sort applied. Under this treatment the cavity will usually close. If the case be one of a glandular cyst with intracystic growth, or if there be much induration of the surrounding mammary tissue, the whole of the affected lobe of the breast should be removed.

Adenoma, Adeno-fibroma, Adeno-sarcoma, and Cysto-sarcoma.—These tumours are so closely allied pathologically that they may be considered merely modifications of a single form of morbid growth. They are all composed of a vascular connective tissue, modified according to the form assumed by the growth, surrounding spaces lined with cubical epithelium, and containing a variable quantity of clear fluid. They are enclosed in a capsule of fibrous tissue, and do not infiltrate the surrounding parts. By most German pathologists the connective tissue is regarded as the essential feature of the growth, and the spaces as more or less accidental remains of ducts or acini, and the term adenoma has consequently not been applied to them by those who hold this view. English pathologists and clinical surgeons have, however, regarded the epithelium-lined spaces as of equal importance with the surrounding connective tissue, and have consequently classed these growths with adenomata.

The following are the modifications met with:—(*a*) A dense, well-developed, fibrous stroma surrounding large spaces, containing little fluid, and consequently flattened or slit-like. This forms the common *adenoma*, or *chronic mammary tumour*.

(*b*) A less perfectly developed fibrous stroma, composed of fibrous tissue abundantly infiltrated with small round cells, or a small amount of fibrous tissue mixed with oat-shaped cells, or of spindle-shaped cells with scarcely any fibrous tissue between them, surrounding spaces containing more fluid, and consequently rounded or oval. This forms the *adeno-sarcoma*.

(*c*) Sometimes the half-developed connective tissue contains numerous stellate cells, and some mucous intercellular substance. This forms the *myxo-sarcoma* or *adeno-myxo-sarcoma*.

(*d*) A tolerably well-developed fibrous stroma, surrounding large spaces filled with fluid, and forming intracystic growths projecting into the cavities, sometimes nearly filling them. This is the *cysto-sarcoma* or *proliferous cyst of the mamma*.

For clinical purposes these tumours may be divided into three groups:—The adeno-fibroma or simple adenoma, the adeno-sarcoma, and the cysto-sarcoma.

Adeno-fibroma. — *Causes.* — These tumours are sometimes attributed to a blow, but we have no real knowledge of their mode of origin. They occur most frequently in young women under thirty.

Symptoms.—The tumour is small when first observed, and situated near the circumference of the gland, usually at the upper or outer part. It is hard, clearly defined, freely movable in the mamma, and has no adhesions to the skin, the deep parts, or the gland. The surface is smooth or smoothly lobulated. It may be painless and free from tenderness, but in hysterical women it is often the seat of intense pain, so much so that the term 'painful mammary tumour' has sometimes been applied to it. Its growth is slow and it may often remain stationary for years; but in other cases it steadily increases, and may attain the size of a small orange without materially altering in its other features.

Pathological Anatomy.—The tumour on section is of a bluish or greyish white colour, becoming pink on exposure to the air; the flattened spaces give it a peculiar foliated structure somewhat resembling the section of a cabbage, which becomes more apparent after the tumour has been immersed in spirit for a short time. It yields no juice on scraping.

Adeno-sarcoma. — An adeno-sarcoma may arise as such, and grow rapidly from the first, or may develop by the rapid increase of a tumour which has presented for many years the appearances of a simple adeno-fibroma. It is met with most commonly in women between thirty and forty. The tumour is lobulated, elastic, painless, and free from tenderness. Its outline is clearly defined, and it is separable from the mammary tissue till it attains a considerable size. Finally, from the tension it causes, the surrounding parts become irritated and adherent to it. The mammary gland may sometimes seem to be involved in the growth, when it is really atrophied from pressure. If the tumour be allowed to grow unchecked, the skin gives way, and a fungating vascular growth protrudes, death taking place from loss of blood and exhaustion. The lymphatic glands are not affected, and recurrence in internal organs is very rare.

Pathological Anatomy.—The tumour on section is usually seen to be perfectly free from adhesion to surrounding parts. It yields in many cases an abundant slimy juice, but on scraping no milk fluid is obtained. Rounded cysts of considerable size are frequently scattered through it.

Cysto-sarcoma, Proliferous Cysts. — These tumours closely resemble in their history and mode of growth the adeno-sarcoma just described, but as a rule they develop more slowly. They occur more commonly after thirty than before. They form elastic lobulated tumours, with fluctuating points scattered through them. They may reach an enormous size without forming any adhesions to the deeper parts. The skin covering them is usually traversed by large veins, but does not become adherent or ulcerate till a late period. If left to grow, ulceration at last takes place and a fungating growth protrudes, and death occurs from exhaustion. The lymphatic glands are never affected and internal recurrences do not occur.

Pathological Anatomy. — A section through the tumour shows it to contain innumerable cysts, varying in size from a pin's head to an orange. The fluid contents are usually thick and viscid. In many of the cysts are intracystic growths. These are usually pedunculated, springing from one side of the cavity and projecting into it like the head of a cauliflower. The solid substance is white or pink in colour, and usually of firm consistence.

Prognosis.—All these tumours are simple in character, and do not return if removed completely.

Treatment.—Small adeno-fibromata are said to have been absorbed under the application of iodine, mercurial ointment, or pressure. It is, however, probable that in every case in which this has been supposed to occur, the tumour was in reality merely an indurated lobule of the gland, resulting from chronic inflammation. The only efficient treatment is removal of the tumour. Even when an adeno-fibroma is stationary, it is wiser to excise it, as it is impossible to say when it may not assume rapid growth and endanger life. In the larger tumours the absence of adhesion to the skin and deep parts renders the removal easy, even when the growth may have attained the size of a cocoa-nut. The breast should not be taken away if it can be avoided, but when the tumour is of great size the gland is so spread out over it and atrophied that it is often impossible to save it.

The removal of the smaller growths is done by a single incision radiating from the nipple. As soon as the capsule is opened, the shining surface of the growth comes into view and the tumour may then often be shelled out by the fingers with the greatest ease. A small pedicle is sometimes found containing the vessels. The operation should be performed with antiseptic precautions, and drainage must be very carefully attended to, lest pus form and burrow deeply beneath the mamma. The safe closure of the cavity is much facilitated by combining elastic pressure with drainage, and for this purpose an absorbent wool dressing will be found of great use.

When the breast cannot be saved, the operation is similar to that for removal of the mamma for cancer, but there is no necessity to remove any skin save that which is actually adherent to the growth.

Fibroma of the Breast.—Pure fibroma of the breast is very rare. It can only be distinguished from the adeno-fibroma by microscopic examination after removal.

Lipoma.—Fatty tumours occur in the immediate neighbourhood of the mamma, and may simulate disease of the breast. Their real seat of origin is the subcutaneous tissue over the gland.

Sarcomata of the Breast. — Various forms of sarcoma are met with in the breast, or its immediate neighbourhood. They differ from the adeno-sarcomata just described in the total absence of any glandular element. Should cysts be present they are due to hæmorrhage or softening of the growth, and not to the presence of epithelium-lined spaces. The most common form of sarcoma met with is the spindle-celled variety, but myxo-sarcoma is not uncommon, and round-celled and giant-celled sarcomata have been occasionally observed.

Causes.—Nothing is known as to the causes of these growths. They are most common in women above thirty.

Symptoms.—In many cases it is quite impossible to distinguish between a soft adeno-sarcoma and a sarcoma, before the growth is removed and submitted to microscopic examination. In other cases the less defined outline, the rapid growth, the uniform semi-elastic or almost fluctuating feel, and the absence of lobulation may lead to a strong suspicion that the tumour is a sarcoma. The lymphatic glands are not affected. If not arrested by treatment these tumours sooner or later implicate the skin, ulceration takes place, a fungating growth protrudes, and death follows from exhaustion.

Pathological Anatomy.—The tumour is soft and pink, and yields a bloody or viscid fluid with shreds of the tumour on scraping. The outline of the tumour will usually be found less clearly defined than that of an adeno-sarcoma, though there is often a fibrous capsule round the growth, yet the tumour cannot be shelled out of it or dissected from the surrounding parts without considerable trouble.

Prognosis.—The prognosis of a pure sarcoma of the breast is always much more grave than that of an adeno-sarcoma. It is in this region that the curious tendency, shown especially by spindle-celled sarcoma, to return locally after removal without affecting internal organs or lymphatic glands, has been most frequently met with. In some fortunate cases the repeated removal of the local recurrences has at last cured the patient, but more commonly the disease soon gets beyond the reach of surgical interference. Recurrence in internal organs is also met with in some cases.

Treatment.—The complete removal of the growth is the only treatment. From the impossibility of accurately distinguishing a pure sarcoma from an adeno-sarcoma, an attempt is usually made in these cases to dissect out the growth. If it be found, on removal, to present the appearances of a pure sarcoma, the capsule surrounding it should be freely dissected away, and it would doubtless be safer, if the patient's consent had been previously obtained, to remove the whole gland. Should local recurrences take place, they may be removed as long as there is any possibility of doing so; and even after no further complete operation is possible, relief may be given by scraping away the fungating mass and freely cauterising its base.

CANCER OF THE BREAST.—All forms of carcinoma are met with in the female breast. The typical variety, forming at least 99 per cent. of all cases, is glandular cancer, usually occurring as scirrhus, rarely as encephaloid, and still more rarely as colloid. Columnar epithelioma has been observed, springing from the ducts, and squamous epithelioma is occasionally met with at the nipple, belonging rather to the skin than to the mammary gland.

Hereditary tendency.—According to Gross an hereditary tendency to the disease existed in one case in 9·72. But Sir James Paget, from the experience of private practice, puts the proportion as high as 1 in 4.

Age.—Cancer of the breast is never met with before puberty. In 642 cases collected and analysed by Gross, 18 appeared between twenty and thirty years of age, 128 between thirty and forty, 245 between forty and fifty, 165 between fifty and sixty, 78 between sixty and seventy, and 8 between seventy and eighty. Thus by far the greater number occur at that period of life at which the reproductive function is ceasing, only 22·74 per cent. arising during the period of greatest activity. The diminution after fifty is not merely due to the fact that in each successive decade fewer women are alive. The proportion of women living between forty and fifty to those between sixty and seventy is about 25 to 16, whereas the proportion of cases of cancer arising in these decades may be roughly given as 25 to 8. The youngest authentic case of cancer of the breast is that recorded by Henry, of Breslau, occurring in a woman aged twenty-one.

The *cessation of menstruation* seems to exert no marked influence. About 61 per cent. of all cases occur before the menopause. In only 6·41 per cent. of cases was the menstrual function irregular.

Social Condition.—It is difficult to say whether the disease is relatively more frequent in married or single women. According to Gross in 88·82 per cent. the patients were, or had been, married, and in 83·91 per cent. they had borne children, and 73·74 per cent. of these had suckled their infants. The disease arose during pregnancy or lactation in about 5 per cent.

The *previous general health* apparently exerts no influence. The great majority of patients enjoy excellent health at the time of the appearance of the disease, and in most cases for some months afterwards.

Local causes.—It is a popular notion that cancer very commonly arises as the result of a blow. According to Gross, 11·7 per cent. of the patients attributed the disease to an injury; but this history must always be regarded with some suspicion, as few women are willing to acknowledge that the tumour arose independently of an external cause. In eight per cent. of Gross's cases the disease attacked a gland which had previously been the seat of puerperal mastitis. Sir James Paget is also of the opinion that chronic indurations not infrequently become the starting-point of cancer after a longer or shorter period. Psoriasis, or eczema of the nipple (*see* NIPPLE, Diseases of the), is a precursor of cancer in not more than one per cent. of the cases.

Varieties of Cancer of the Breast.—For the purposes of clinical description, cancer of the breast may be thus divided:—A. Scirrhous or hard cancer. *a.* Nodular or circumscribed scirrhus; *b.* infiltrating or diffused scirrhus; *c*, atrophying or atrophic scirrhus; *d*, cancer '*en cuirasse.*' B. Encephaloid, or soft cancer. C. Colloid cancer. D. Cystic cancer. E. Duct or villous cancer. Of these forms, scirrhous, encephaloid, and colloid cancer are varieties of glandular carcinoma; that is to say, they are composed of cells of the type of glan dular or spheroidal epithelium, filling the spaces of an alveolar fibrous stroma. In scirrhus the stroma is abundant, and consequently the tumour is dense and hard; in encephaloid the proportion of cells to stroma is such that the mass is comparatively soft; while in colloid the structure is modified by the colloid degeneration of the cells. Intermediate forms between scirrhus and encephaloid are not uncommonly met with, and, in cases of colloid cancer, parts of the tumour usually have escaped degeneration and present the appearance of ordinary cancer. Cystic cancer is very rare; it arises apparently from the softening and disintegration of the central parts of a soft cancer. Villous or duct cancer arises from the galactopherous ducts, and is characterised by the presence of columnar epithelium. It differs so much from the other forms as to require a separate description. It is difficult to state with accuracy the relative frequency of the various forms. Colloid, cystic, and villous cancer together would probably not form 1 per cent. of all cases. Of the remainder, about 85 per cent. would be ordinary scirrhus; 5 per cent. encephaloid; and the remainder atrophying scirrhus, cancer *en cuirasse*, &c.

SCIRRHUS.—*Symptoms.*—The *nodular* or *circumscribed* variety forms the type of cancer of the breast. The course of an ordinary cancer of the breast, unrelieved by treatment, may be divided into three stages. First, when the disease is limited to the gland; secondly, the stage of implication of the skin and the axillary lymphatic glands; and thirdly, the stage of ulceration and general infection.

First stage.—During the first stage the symptoms are entirely local. The patient may possibly lose flesh towards the end, but there is no constitutional condition characteristic of cancer. The chief symptom is the appearance of a hard lump in the breast, which slowly but steadily increases in size. In the majority of cases the tumour is discovered accidentally, as while washing, or the attention may be directed to it by a blow. Pain is not a marked symptom during the early periods of the disease, and may be entirely wanting till the second stage. Inspection of the breast shows nothing till towards the end of the first stage. Slight enlargement may then be perceptible; but as, in cancer, the new growth replaces the original structures, this is not so marked as in simple tumours of the same size. Retraction of the nipple is a common symptom towards the end of the first stage. The period at which it occurs depends considerably upon the situation of the tumour. If the cancer is in an outlying lobule, it occurs late or may be absent. If the disease is immediately under the nipple, retraction takes place early. By manipulation a hard nodule is recognised in the gland, most commonly situated either in the upper and outer segment or near the nipple. The nodule is single and tolerably clearly defined in outline, but a careful examination shows that it forms part of the gland itself. By the time the surgeon is called to see the case the tumour is seldom smaller than a filbert. It cannot be slipped about independently of the gland, and, if it be pushed away by the fingers of one hand while the nipple and areola are steadied by those of the other, the distinct connection of the tumour with the nipple by means of the ducts can be clearly recognised. The surface of the tumour is usually coarsely nodulated or irregular. Quite early in the disease, if the finger and thumb be placed about two inches apart so as to include the tumour between them, and the skin be then pinched up, a tendency to dimpling will be noticed over the nodule. In very exceptional cases there is a thin serous discharge from the nipple.

A combination of the above symptoms in a patient above thirty years of age justifies a further examination of the growth by incision. The duration of the first stage of cancer of the breast, according to Gross, averages 14·1 months.

Second stage.—As the tumour increases in size it gradually invades more and more of the gland, but, as it replaces the mammary tissue and contracts in its central parts while growing at its circumference, the actual increase in the bulk of the mamma is rarely very great. As the cancer approaches the surface, the skin becomes increasingly fixed over it, and finally infiltrated by it. When this has taken place the affected skin becomes smooth and leathery in consistence. It usually assumes a dusky red or brownish colour. If examined with a lens, small vessels are usually seen ramifying in it. The area of skin implicated varies in different cases, but it seldom reaches more than an inch in diameter before ulceration sets in. The tumour, although increased in size, retains its characteristic hardness, the central parts being the most dense. The retraction of the nipple becomes more marked. Pain is now almost a constant symptom, scarcely 10 per cent. escaping. It is acute, lancinating or burning, often severe at night, disturbing rest, and thus causing impairment of the general health. Sometimes it radiates for some distance from the breast, often to the shoulder. It is usually increased by handling the diseased breast, but there is rarely acute tenderness.

Enlargement of the axillary glands commences to be perceptible on an average about the fifteenth month. The frequency with which recurrence in the glands takes place after excision of the breast in the first stage of the disease is, however, clear proof that the actual infection takes place at a much earlier period, and that the absence of enlargement perceptible to the finger is no proof that the glands are sound. The glands first affected are usually those at the lower and anterior part of the axilla. In feeling for them the arm must not be raised, as, by so doing, the axillary fascia is put on the stretch, and thorough examination of the armpit becomes impossible. The general health suffers but little during this stage of the disease. Loss of flesh is almost a constant symptom, but in other respects there is little change.

Third stage.—The average period at which ulceration sets in is 20·2 months. It may commence in two ways. In the great majority of cases a small fissure forms in the affected skin, from which a sanious discharge escapes. This dries and forms a scab. After a time the scab falls off, and leaves an ulcer exposed. The edges of the ulcer are hard and raised, the surface is pinkish in colour, sometimes irregular, but more often smooth, and without granulations. In other cases it may be covered with a yellowish slough. The ulcer may remain superficial, or may extend into the tumour, forming a deep, foul cavity. The discharge is peculiarly offensive, the smell being that always met with whenever epithelial structures are decomposing. The pain is usually constant and severe.

In exceptional cases the ulceration is preceded by softening of a portion of the growth beneath the affected skin; this subsequently gives way, and a deep cavity is formed from the beginning. Hæmorrhage from the ulcerated surface is not uncommon, and is occasionally the immediate cause of death. By the time ulceration sets in, or soon after, the tumour frequently becomes adherent to, or implicates, the pectoralis major. This is recognised by its becoming fixed when the muscle is thrown into forced contraction. The glandular enlargement, which commenced during the second stage, extends during the third. The enlarged glands are more clearly felt, and often cause fulness beneath the clavicle. The supraclavicular glands, and even those behind the sterno-mastoid, may become affected. The pressure of the glands on the axillary vein at this time often causes great swelling of the arm, and severe neuralgic pain shooting down the limb may arise from pressure on the cords of the brachial plexus.

Should the patient not perish from the effects of the local disease and that of the axillary glands, infection of distant organs now takes place. This occurs in about half of those who are allowed to die unrelieved by operation. The organ most commonly affected is the liver. The enlargement of the liver may be ascertained by percussion, and the secondary tumours felt on the surface, below the costal margin. Jaundice, more or less marked, is a common symptom, but there is seldom much pain. The lungs are affected with half the frequency of the liver. The pleura, on the side corresponding to the diseased breast, is implicated more frequently than the lung, effusion often taking place, which is occasionally the immediate cause of death. Next in order to these organs, but far behind them, come the bones. Spontaneous fracture of long bones, or disease of the vertebræ, with the rapid occurrence of angular curvature, are the most common manifestations of secondary growths in the bones. Secondary tumours may occur in any other part of the body, but are rare except in the situations just mentioned.

During the whole of the third stage the general health suffers severely. The patient emaciates, and loses strength and appetite, the complexion becomes sallow, and the appearance—commonly described as that of the cancerous cachexia—becomes marked.

Death takes place on an average 27·1 months from the first appearance of the disease. The immediate causes of death may be exhaustion from pain and discharge, chronic septicæmia from absorption of the decomposing discharge, hæmorrhage, or secondary visceral disease.

The foregoing may be taken as a summary of the typical symptoms of cancer of the breast, as observed in an ordinary circumscribed scirrhus. In describing the course of the other varieties of the disease, it will only be necessary to indicate the points in which they deviate from the type.

(*a*) *Infiltrating or Diffused Scirrhus.*—This is far less common than the nodular form. It may commence as several small nodules, which coalesce as the disease advances, thus forming a large, hard, ill-defined tumour occupying the whole mamma. This diffused form of the disease grows more rapidly than the circumscribed, and causes considerable enlargement of the breast. The nipple is deeply depressed, as much by the projection of the growth round it as by retraction. The whole mass is hard, scarcely elastic, and lobulated on the surface. The skin may be extensively adherent from an early period. The pain is variable, rarely severe. Glandular affection occurs early. When ulceration takes place it extends deeply into the mass, forming a foul cavity of great size.

(*b*) *Atrophic, Atrophying, Withering, or Cicatricial Scirrhus*.—This form may occur at any age, but is more common in old than in young women. The tumour is of slow growth, and shows in an extraordinary degree the tendency to contraction, which is to a less extent met with in all forms of scirrhus. The affected breast is thus, in spite of the presence of the new growth, actually smaller than its fellow. The nipple is deeply retracted, and when the skin is implicated, the affected part may be drawn together like the scar of a burn. There is usually but little pain. The ultimate course of the disease is the same as in ordinary scirrhus, ending in implication of the lymphatics and infection of distant parts; but the average duration of life in cases not operated on is eighty-two months, patients having been known to survive fifteen, or even twenty, years.

(*c*) *Cancer 'en cuirasse*.'—This is a rare form of the disease. It commences in the mammary gland, usually as the ordinary nodular form, but more rarely as the atrophying. The peculiarity consists in the rapid extension in the skin as soon as the disease reaches the surface. This may take place by continuous extension, or numerous small flat tubercles may appear dotted round the central point at which the skin is implicated, and these gradually increase and coalesce. In one of these ways the whole skin of the front and side of the chest may be affected, from the clavicle to the level of the umbilicus. The skin becomes of leathery hardness and toughness, and of a dusky, brownish-red colour, and is tightly stretched over the parts beneath. Ulceration may occur in several points at the same time. This form of cancer is accompanied almost invariably by intense burning pain, and is usually speedily fatal.

Pathological Anatomy.—A typical scirrhus when removed is characterised by the hardness of its structure, the knife even creaking as it passes through it. The cut surface immediately becomes concave, in this respect differing from all other tumours. This is due to the degeneration of the cells and consequent shrinking of the central parts, while the contraction is limited by the density of the surrounding parts of the growth. The section is greyish-white in colour, and streaked by whitish or yellowish-white lines and dots, thus presenting the appearance of a section of an unripe pear. Its circumference is seen to be implicating the surrounding tissues, portions of undestroyed fat being frequently imbedded in the fully-formed cancer-tissue. On scraping or squeezing, it yields an abundant milky juice. In the infiltrating form the structure is more uniform, often lobulated, and of a white or pinkish-white colour. Its surface becomes less markedly concave when the breast is cut across, and it yields a more abundant milky juice. In the atrophic form the tumour is small, very dense, its surface becomes very markedly concave, and it yields but little juice on scraping.

The microscopic characters are fully described under cancer. *See* CARCINOMA. It is sufficient to say here that the cells are arranged most commonly in lines or tubes in the denser forms, and in rounded spaces in the less dense varieties, especially in the infiltrating scirrhus, in which the structure is often spoken of as acinous. In the central part the cells are found to be undergoing fatty degeneration, and it is to this change that the shrinking is chiefly due.

Prognosis of Scirrhous Cancer.—The prognosis of scirrhous cancer is hopelessly bad, unless the patient be relieved by operation. The more active the growth, the more rapidly does secondary infection take place; thus, in ordinary nodular scirrhus, the average duration of life is only 27·1 months, while, in the shrinking or atrophic form it is as much as 82 months. Cancer '*en cuirasse*' is always very rapidly fatal. As a rule, the younger the subject the more active is the growth, and the shorter the duration of life; but this rule is not without exceptions. Pregnancy always adds greatly to the gravity of the case, for, as the mamma enlarges, the tumour increases with fearful rapidity. The effect of operation on prognosis will be discussed later on.

ENCEPHALOID CANCER.—True soft cancer —that is to say, so soft as to justify the term brainlike—is very rare in the breast, as elsewhere. The so-called soft cancers of the breast are usually firm and elastic, lobulated, and of rapid growth; and every intermediate form is met with between them and the less dense varieties of scirrhus. Soft cancer occurs at the same age, and under the same conditions, as scirrhus. It most commonly infiltrates the whole gland rapidly, but occasionally remains limited to one part. The tumour reaches a considerable size in a few months, causing, from an early period, an evident enlargement of the gland. Retraction of the nipple is an occasional symptom, and is often more apparent than real, being due rather to the projection of the implicated tissues round it. Dilated veins are commonly seen over the distended gland, and there may be some abnormal redness of the skin. Manipulation shows the mass to be tense and elastic ; not unfrequently there is considerable œdema of the subcutaneous tissue. In exceptional cases the central parts of the tumour may be broken down by hæmorrhage, and there may thus be distinct fluctuation. The progress of the case is the same as that of scirrhus, but greatly exaggerated and accelerated. The glands are early affected, the skin becomes implicated, ulceration takes place, with the formation of a deep foul cavity, from which hæmorrhage is very prone to occur. The tumour soon forms deep attachments, and secondary growths appear in the viscera and elsewhere. The general health suffers early and severely.

Prognosis.—The average duration of life in soft cancer of the breast is under one year. Even after removal of the breast it is said to be only sixteen and a half months, death being due either to local recurrence or secondary growths in the viscera or elsewhere.

Pathological Anatomy.—The tumour on section is of a uniform white or pinkish-white colour, sometimes stained in parts brownish or reddish-brown from hæmorrhage. The growth is often markedly lobulated ; its cut surface is convex or flat. It yields a very abundant milky juice on scraping. Microscopic section shows the characteristic alveolar stroma filled with cells of an epithelial type. These may be of great size, or may differ but little from those of scirrhus, the essential difference being in the relative proportion of stroma to cells rather than in those structures themselves. In rare cases the stroma is excessively vascular, and vascular processes project from the walls of the alveoli into the spaces. It is in cases of this kind that the structure may be extensively broken down by hæmorrhage.

Colloid Cancer in the breast is very rare. It is merely a modification of scirrhus, due to colloid degeneration of the epithelial cells contained in the alveoli. In its early stages it differs in no respect from ordinary scirrhus, but the degeneration of the cells seems to retard the growth of the tumour. Gross states that the average duration of life, in cases not operated on, is 144 months. As colloid degeneration tends to increase the bulk of the growth, the tumour does not show the tendency to retraction which forms the marked feature of ordinary scirrhus. The nipple is not drawn in ; the tumour, as it grows, assumes considerable proportions, and when it implicates the skin it forms a projecting nodule, often of considerable size, before ulceration takes place. When ulceration commences, it proceeds slowly, the surface being sometimes covered with a crust or scab formed of the dried colloid matter. Infection of the lymphatic glands and internal organs follows in due course, and the secondary tumours may have the structure of ordinary scirrhus or assume the form of colloid cancer.

Pathological Anatomy.— The whole tumour has very rarely been found to have undergone colloid degeneration. More commonly the peripheral parts present the ordinary appearance of scirrhus. In the degenerated part the alveolar spaces are distended with colloid matter, so as to be clearly visible to the naked eye. We thus get an evident alveolar stroma, filled with a transparent gelatinous material of a delicate or yellowish-pink colour. *See* Carcinoma.

Prognosis.—The prognosis of colloid cancer is ultimately bad, but life is prolonged, in cases not operated on, for a longer period than in any of the other forms of disease.

Duct Cancer or Villous Cancer.—This rare form of cancer of the breast was first accurately described by Cornil and Ranvier. It resembles ordinary cancer in infecting neighbouring parts, lymphatic glands, and distant organs. To the naked eye it somewhat resembles soft cancer, and yields an abundant milky juice. On closer inspection, small cysts are seen, partly filled by dendritic filaments projecting into the cavity, the remaining space being occupied by a milky fluid. Sometimes the milky fluid is replaced by extravasated blood. Microscopic examination shows that the spaces are surrounded by a fibrous wall, from which the branching papillæ spring. These are very vascular, and covered with epithelium arranged in several layers. It is either cylindrical or cubical, with a tendency to assume the cylindrical form. The milky juice contains the degenerated cells which have been cast off. From the resemblance of the epithelium to that lining the milk-ducts, it is highly probable that these spaces arise primarily from those structures, and hence the name 'duct cancer.' Billroth describes a growth apparently similar under the name of 'soft cysto-adenoma.' He says: 'If one looked at the specimen without knowing whence it came, one would think it might be from a polypus of the rectum or uterus.' When the growth is broken down by hæmorrhage, it closely resembles a soft sarcoma in appearance. The *clinical features* of the disease cannot yet be accurately defined. Some of the cases recorded have been taken for ordinary scirrhus, and some for sarcomata, before removal. The disease may be preceded by a bloody discharge from the nipple, as in duct-cysts. The prognosis is uncertain. Billroth's case occurred in a woman of twenty-four, and did not recur after removal. Other cases have run a malignant course, like that of ordinary cancer.

Treatment of Cancer of the Breast. No drug has as yet been discovered that exerts the slightest influence on the progress of cancer of the breast. The sole treatment which need be considered is the removal of the tumour, and this can only be effected by the knife or by caustics. Pressure, applied by means of various ingenious instruments, was at one time said to have caused the absorption of cancerous growths, but there is no trustworthy evidence that such a result has ever been obtained. Caustics have been extensively used by quacks and but little by surgeons. They are uncertain in their effect, it being impossible to be sure that the whole growth, and much less the whole gland, is removed. They are, moreover, extremely painful, and are quite inapplicable to cases in which the axillary glands are diseased. The removal of the disease by the knife is almost painless, is more speedy, and more certain, and no surgeon is justified in recommending the use of caustics as a substitute for it. It has been said that caustics are occasionally useful when the patient is either unfit to bear an anæsthetic, or too weak to stand a cutting operation. Such cases are equally unfit for caustics, and had better be let alone. The operation by the knife is therefore the only treatment we need consider.

Excision of the breast may be undertaken in all cases of cancer, while the disease is apparently limited to the mamma, unless contraindicated by diabetes, Bright's disease, extreme old age, or some other condition unfavourable to any surgical operation. Extreme fatness, although not alone a barrier to the operation, is an unfavourable condition, and, if combined with old age, is sufficient to render it inadvisable.

In the second stage of the disease, when the lymphatics and skin are affected, the operation may still be undertaken, if the diseased glands be limited to the axilla, and if the general health be good. The liver and other organs should always be carefully examined for secondary growths. In the third stage the mere fact of ulceration is of little importance. The question of operating must be determined by the general health, by the extent of the implication of the skin and lymphatic glands, and by the evidence of visceral infection.

The operation is contraindicated when both breasts are affected, when the glands above the clavicle are distinctly enlarged, when the glandular enlargement has caused œdema of the arm, when the deep adhesions of the tumour are such that there is reason to believe the chest-walls are implicated, and when the so-called cancerous cachexia is so manifest as to give rise to a suspicion of visceral implication.

The form of cancer also exerts some influence in determining the propriety of operating. The simple nodular scirrhus is always favourable for removal in its early stages; infiltrating scirrhus must be removed early, if at all, or it will most likely return locally; cancer '*en cuirasse*' is never suited for operation. Atrophying scirrhus and colloid cancer, being of slow growth, are favourable cases for operation. Encephaloid cancer, unless taken very early, may as well be let alone, as local recurrence is very prone to occur.

Should an operation be determined on, it is a universally received rule that the whole gland, including the nipple, should be removed. It is an equally well-recognised rule that, if the skin is implicated, the incisions must be carried very wide of the diseased part, and that, if the glands are enlarged, they must be removed at the same time as the breast. During the last few years many surgeons, amongst whom may be mentioned Küster, Banks, and Billroth, have strongly advocated the removal of the axillary glands in every case, whether any enlargement can be felt or not. The results of this practice have been such that there can be little doubt that it will before long become an established rule of surgery. Küster states that in one quarter of the cases treated in this way the patient has remained well three years after the operation, which he considers a sufficient time to justify the belief that the cure was permanent.

Before commencing the operation the skin of the axilla should be shaved. The patient must be placed on a table of convenient height, and the arm must be raised and retained in that position, either by a bandage or by the hand of an assistant.

The incisions must necessarily be varied according to the situation of the tumour and the degree of implication of the skin. The operation is most commonly done by two curved incisions, including between them the whole of the skin covering the tumour. These incisions are so placed that the long diameter of the oval piece of skin included between them is parallel to the fibres of the pectoralis major. It will be found, however, that better drainage is obtained if they are so arranged that the long diameter is transverse, the angle of union of the two incisions being on the inner side near the sternum, and on the outer side at the lower part of the anterior fold of the axilla. If the oblique incision is adopted, the lower flap must be raised first, so that blood flowing from the upper may not inconvenience or obscure the view of the surgeon. In raising the flaps enough fat must be taken to ensure their vitality, and no more. It is advisable to remove the greater part of the fat about the gland with the breast. The dissection must be continued till the border of the gland is passed, and then carried more deeply till the fibres of the pectoralis major come into view. The other flap is then raised in the same way. Finally the whole breast is removed, the knife being carried along the fibres of the muscle so as to remove the fascia covering it with the breast. The whole operation should be done by clean dissection, with as little tearing as possible. Every bleeding vessel should be immediately seized when cut, by forci-pressure forceps, so as to diminish the loss of blood. The mass removed must then be carefully examined, and, if any lobule of the mamma has been left behind, it must be dissected out. If the tumour is adherent to the pectoralis major, it is better to remove the muscular tissue freely, either with the breast or afterwards.

Should it be intended to remove the glands, the axillary space must now be freely opened up. During this stage of the operation the arm must be held by an assistant, as the surgeon often requires to vary its position as the dissection is carried on. If the oblique incision has been adopted the axilla may be opened by carrying the knife upwards from the upper angle of the wound to the arm. If the transverse incision has been chosen, a cut must be made from near its outer end upwards to the arm, along the anterior border of the axilla. The glands should then be removed, with the fat of the axilla, by a process of careful dissection. It should be commenced at the anterior border and carried upwards, a blunt instrument being used as the axillary vein is approached. Any doubtful bands appearing to contain vessels should be tied with catgut ligatures before being divided. In this way the axillary vein is reached and exposed, and the upper part of the contents of the axilla freed. The dissection can then be carried downwards and backwards, care being taken to avoid the subscapular artery and vein, if possible. Unless a sharp look-out is kept for these vessels, they may be cut so close to the main trunks that a ligature can scarcely be applied, and it might thus become necessary to ligature the axillary artery. The intercosto-humeral nerve is divided, and usually the external mammary artery. A small gland, often found between the edges of the two pectoral muscles, should be sought for and removed. The thorough cleaning out of the axilla requires care and patience, but is not specially dangerous. The danger of entrance of air in an accidental wound of the axillary vein, or of a large branch entering it, must not be forgotten. *See* Air in Veins. The plan sometimes adopted of opening the axillary fascia and hooking out such glands as may be felt with the finger, is far less efficient than that just described. When it is adopted, more glands are usually left behind than are removed.

The after-treatment of the wound presents nothing peculiar. Drainage must be carefully provided for by the insertion of tubes. Button sutures must be used to bring the edges of the main wound together if there is much tension. Antiseptic treatment of some kind should be adopted whenever possible. The spray is perhaps the most efficient means of irrigation during the operation; but, if the surgeon prefers not to use it, the wound may be washed out with carbolic acid lotion (1 in 40), tr. iodi and water (f ʒij. to Oj.), bichloride of mercury (1 in 1,000), or chloride of zinc (20 gr. to f ℥j.) before the stitches are inserted. The dressing should also be antiseptic, but the form adopted must vary with the preference of the surgeon. Carbolic gauze is well adapted to most cases. Very good results are also obtained by permanent dressings of salicylic wool or iodoform wool. *See* ANTISEPTIC SURGERY; WOUNDS.

Results.—The mortality from the operation is very small. When death does occur it is most commonly from pyæmia, septicæmia, or erysipelas. There are no dangers peculiar to the operation.

But few patients, however, are cured. It is generally recognised that life is lengthened, and that in many cases an easier death is substituted for that from ulceration and exhaustion. The statistics at present before the profession show that life is prolonged by the operation—in scirrhus by about twelve months, and in encephaloid by about eight months. These are, however of little value. In order to draw any just conclusions, those cases which are operated on merely to give relief should be excluded. A separation should also be made between those in which the axilla is cleared out, and those in which the breast only is removed. There is no doubt that the more extensive operations performed at the present time give much better results, but the numbers recorded are not at present sufficient to draw any accurate conclusions from them.

When recurrence takes place, it may be in the scar, in the glands, or in distant parts. If the axillary glands have not been removed before, they may be taken away when the recurrence appears. If they have been removed and the recurrence is above the clavicle nothing can be done. Recurrences in the scar are best avoided by the freest possible removal of skin at the operation. Should they occur, great relief is often given by their removal, but any permanent cure is out of the question.

The *treatment of cancer not operated on* is very unsatisfactory. Antiseptics should be applied as soon as ulceration sets in, to correct the offensive odour. Among the best of these is an ointment composed of eucalyptus oil, ♏xx., iodoform gr. v., and vaseline ℥j. Carbolic acid is often too irritating; boracic-acid lint, terebene and oil, and washing with Condy's fluid are often useful. Conium poultices have been said to relieve the pain. Possibly cocaine might be of service. Sooner or later it is usually necessary to fall back on opium, given internally. It is most efficiently administered as hypodermic injections of morphia.

DISEASES OF THE MALE BREAST.—The male breast is but little subject to disease. Mastitis neonatorum (see *Mastitis*) is equally common in the two sexes, and at puberty some swelling of the rudimentary gland is not uncommon. In adult life the breast is occasionally chronically inflamed, enlarged, and indurated. This is best treated by the application of belladonna. If this fails, tincture of iodine may be tried, and, as a last resource, if the tenderness and inconvenience are considerable, the whole gland may be excised.

Cancer of the Male Breast is occasionally met with. It appears almost invariably as scirrhus, and runs the same course and requires the same treatment as in the female. MARCUS BECK.

BREAST, Tumours of the, Diagnosis of.—In examining the breast for any disease the whole gland must be fully exposed. Neglect of this precaution is a common cause of errors of diagnosis. The patient should be in the recumbent position, so that the breast may be well supported by the ribs; in the erect position elasticity or fluctuation are readily overlooked. The diagnostic signs of the various growths differ so much in the early and late stages, that it is convenient to divide the tumours into (A) large, or those exceeding a large orange in size; (B) medium-sized or those between an orange and a walnut; and (C) small. Of course all tumours are originally small, and in this stage diagnosis is most difficult; but many never reach any great size, and others cause so little inconvenience that the patient allows them to attain a considerable bulk before consulting the surgeon. Unfortunately also, many are still allowed to increase to the medium or even large size by the pernicious practice of waiting till the nature of the growth becomes evident. If the surgeon is in any doubt, it is his duty to advise the patient to have the tumour examined by incision. When the nature of a malignant tumour becomes so clear that a mistake is impossible, it is usually too late to operate with any hope of permanent cure.

(A). LARGE TUMOURS OF THE BREAST.

1. *The tumour arises in connection with lactation.*—Galactocele. Milk can be withdrawn by the aspirator. *See* GALACTOCELE.

2. *The tumour does not arise as a consequence of lactation.*

(*a*) *It is of more than twelve months' growth, and the axillary glands are not enlarged.*—(α) Adeno-sarcoma, and (β) cysto-sarcoma.

a. Adeno-sarcoma—Does not implicate the mammary tissue; is smooth, elastic, lobulated, clearly defined in outline; not adherent to the skin, unless of great size; may fluctuate in parts and is painless. The nipple is spread out, but not retracted or buried. It often arises by a sudden increase of growth in a very chronic tumour; it is most common between thirty and forty.

β. *Cysto-sarcoma.* — Closely resembles the adeno-sarcoma, but is more lobulated, and the fluctuating cysts are more distinct and numerous. It is of slower growth, and occurs most commonly between thirty and fifty.

(*b*) *The tumour is of about twelve months' growth, and the glands are not enlarged.*—Sarcoma.

Sarcoma.—Does not usually infiltrate the gland; is clearly defined, but less so than adeno-sarcoma or cysto-sarcoma; is elastic or semi-fluctuating, smooth or coarsely lobulated on the surface. It is of rapid growth and painless. The nipple is not retracted or buried. The skin is not implicated till late. It is most common between thirty and forty.

(*c*) *The tumour is of less than twelve months' growth, and the axillary glands are enlarged.*—Encephaloid cancer.

Encephaloid cancer infiltrates the gland. It has an ill-defined outline; its surface is lobulated; its consistence varies from semi-cartilaginous, elastic hardness to almost fluctuating softness; the skin covering it is early fixed to it and often œdematous, sometimes red; it is of very rapid growth and usually painful; the nipple is early buried by the swelling rather than retracted; the growth is adherent to the deep parts. It is most common between forty and fifty, but may occur at any age after thirty.

Dilated veins over the surface of the breast occur in all large tumours, and are of no diagnostic value. Ulceration may occur in all, but it takes place soonest in encephaloid cancer. The formation of a vascular, prominent, fungous mass is evidence of the sarcomatous nature of the growth. Cancer sloughs rather than fungates, forming a deep, foul excavation.

(B). MEDIUM-SIZED TUMOURS.

1. *The tumour does not implicate the mammary tissue, and can be moved without dragging on the nipple.*—(*a*) Adeno-fibroma, (*b*) adeno-sarcoma, (*c*) cysto-sarcoma, (*d*) fibroma, (*e*) sarcoma.

(*a*) *Adeno-fibroma.*—It is of slow growth, rounded or slightly lobulated, dense and hard, inelastic; may be painless, but is often painful. It is most common under thirty.

(*b*) *Adeno-sarcoma* closely resembles an adeno-fibroma, but is of more rapid growth, perhaps following a long period of slow growth and being less dense. It is more common between thirty and forty.

(*c*) *Cysto-sarcoma* cannot be distinguished from an adeno-sarcoma at this stage, unless the cysts cause very distinct lobulation and can be recognised by fluctuation.

(*d*) *Fibroma.*—A pure fibroma cannot be distinguished from an adeno-fibroma.

(*e*) *Sarcoma.*—A sarcoma is less clearly defined than the foregoing tumours; it is softer, sometimes elastic or semi-fluctuating, seldom lobulated, painless, and of rapid growth. It occurs commonly between thirty and forty.

At this stage none of the foregoing tumours form deep adhesions, they do not cause enlargement of the glands, and produce no deformity of the nipple. They are not adherent to the skin.

2. *The tumour implicates the mammary tissue, so that the nipple is dragged on when the growth is moved away from it, and connection by means of the ducts can be felt.*—(*a*) Cysts; (*b*) Cancer.

(*a*) *Cysts.*—These are painless, of slow growth, fluctuating or elastic, or sometimes so tense as to be of almost stony hardness. They are smooth on the surface or coarsely lobulated. The skin does not dimple over them, nor is there œdema. If one part can be felt to be softer or more elastic than the rest it is the centre. They are most common between thirty and forty.

The chief kinds of cysts are—*a. Glandular or duct cysts* are often multiple; their contents can sometimes be emptied from the nipple by pressure, or there may be a history of a bloody discharge at some time.

β. *Serous cysts* cannot be emptied by pressure, and are usually single.

γ. *Hydatid cysts* cannot be recognised without puncture.

If there is any suspicion that the tumour is cystic it should be punctured with a fine trocar. If the contents are brown and bloody, it is, probably, a glandular or duct cyst; if clear and rich in albumen, it is, probably, a serous cyst; if clear and nearly free from albumen, a hydatid cyst. The fluid must then be searched for hooklets. Hydatid cysts are very rare.

(*b*) *Cancer.*— Cancer, in this stage, is adherent to the skin, as shown by dimpling when the integuments are pinched up, or may be actually implicating the skin, or even ulcerating. It is very painful, the pain being lancinating and burning. It is but slightly tender. It is of rapid growth. The nipple is very frequently retracted. The tumour may be fixed to the deep parts and the axillary glands are enlarged.

The different forms of cancer are thus distinguished.

α. *Scirrhus* is very hard, the centre being the hardest part; its outline is tolerably clearly defined, but not sharply circumscribed; its surface is usually nodulated; it very rarely forms a medium-sized tumour without implicating the skin and glands. The nipple is almost invariably deeply retracted, especially if the tumour be near the centre of the gland. The duration of the growth is usually about a year before this size is reached. It is very painful.

β. *Soft cancer* is elastic, very ill-defined; its surface is smooth or lobulated; it is often less painful than scirrhus; the nipple is less frequently retracted. It may reach a medium size without actually implicating the skin, but there is dimpling over it if the integuments are pinched up. The axillary glands are early implicated. It rarely lasts six months without reaching a medium size.

γ. *Colloid cancer* is almost painless, and of much slower growth. It is lobulated and elastic, the outer parts being sometimes harder than the centre. It causes the same dimpling of the integuments when pinched up, and, when implicating the skin, may form a considerable projection without ulcerating. The nipple is rarely retracted; the lymphatic glands are enlarged. It may take two years or more to reach a medium size.

In medium-sized tumours, if there is any doubt as to the nature of the growth, an incision must be made into it, but this is less frequently required than in small growths.

(C). Small Tumours.—In addition to all the tumours before mentioned, which must at some time be small, there are three which never pass beyond this, the small size: chronic induration from mastitis, chronic encysted abscess, and atrophic scirrhus. The diagnosis of the small tumours is conducted on the same principles as that of the medium-sized.

1. *The tumour does not implicate the mammary tissue. Adeno-fibroma, adeno-sarcoma, cysto-sarcoma, fibroma, and sarcoma.*—These cannot be distinguished from each other in this stage, unless the points already mentioned can be made out.

2. *The tumour implicates the mammary tissue.* (*a*) Cyst. (*b*) Chronic inflammatory induration of a lobule. (*c*) Chronic encysted abscess. (*d*) Cancer.

(*a*) *Cysts* present the same features as when they are larger, but the difficulty in recognising them is far greater.

(*b*) *Chronic induration of a lobule.*—The indurated lobule is ill-defined, of leathery hardness, often nodulated from the pressure of small retention-cysts; the integuments do not dimple over it when pinched up, except when the lobule is very near the surface, in a thin subject. The skin is never implicated, nor is the nipple retracted. The tumour is of very slow growth and after a time becomes stationary. It is sometimes painful and often tender, especially at the menstrual period. There is no enlargement of the axillary glands. It occurs most commonly in women who have borne children, but may be met with in others. It may occur at any age, but becomes less common after forty-five. Several such lobules may be found in the same breast, and both sides may be affected.

(*c*) *Chronic Encysted Abscess* closely resembles the indurated lobule just described, but it arises almost invariably after lactation or after a miscarriage, and there is usually some slight œdema of the skin over it. Dimpling of the integuments on pinching them up is common. The induration is usually leathery, but if the contents of the cavity are at some degree of tension it may be of stony hardness.

(*d*) *Cancer*, when very small, is recognised by the very early dimpling and the stony hardness. It may occur at any age over thirty. There is usually no actual implication of the skin, no retraction of the nipple, no enlargement of the glands, no deep fixity of the tumour, and most frequently no pain—in fact, few of the signs which are certainly diagnostic of cancer. Should any of them be present with a small tumour their importance is greatly increased.

The early stages of a soft cancer or a diffused scirrhus are still more difficult to recognise, as they so closely resemble inflammatory induration. Primary cancerous tumours are almost invariably single. Atrophic scirrhus is usually easily recognised by the slow progress of the disease, the great retraction of the nipple, the scar-like shrinking of the affected skin, and the stony hardness of the growth.

The diagnosis of small tumours is thus very uncertain, and yet if the disease is malignant the only hope of cure lies in early recognition of its nature. In these cases, therefore, an exploratory incision should always be made. If the tumour is one of the simple growths, its smooth surface will be seen as soon as the capsule is opened and the mass can be turned out without difficulty. If it is a sarcoma its soft structure and less perfect outline will be recognised. If it is a cyst or an abscess the contents escape; and if it is an indurated lobule, its leathery toughness and perhaps the small retention-cysts will be recognised. If it is a scirrhus, the creaking of the knife as it enters it, and the sensation like cutting an unripe pear, and its sharp hard edge, not separable from the surrounding tissues, clearly show its nature.

If the case is a very doubtful one a freezing microtome and a microscope should be at hand, and a section should be mounted from a small slice taken from the growth. In this way all doubts are set at rest. 'Waiting till symptoms develop' in the case of cancer means waiting till all hope of cure is gone.

The difficulties of diagnosis are so great that it is a good rule, even if the cancerous nature of the growth seems almost certain, to cut into it before removing the whole breast. Many accidents might have been prevented by adopting this simple precaution. *See* Breast, Diseases of the.

Marcus Beck.

BROAD LIGAMENTS, Diseases of the.—The broad ligaments may be the seat of inflammatory deposits (cellulitis), of abscess, of hæmatocele, of solid neoplasms, and of a variety of cystic tumours. The inflammatory deposits, abscesses, and hæmatoceles will be dealt with in the special articles—Pelvic Abscess; Pelvic Cellulitis; Pelvic Hæmatocele.

The Solid Tumours are very rare, and are so closely incorporated with either uterus or ovary that they are usually confounded with growths of those organs. It is, however, quite certain that fibroma, fibro-myoma, sarcoma, myxoma, and lymphadenoid tumours may grow in the broad ligament, independently of both uterus and ovary. The myxomatous and lymphadenoid growths may attain an enormous size and closely simulate like tumours of the uterus. Their causes, symptoms, diagnosis, and treatment cannot be at present separated from those of the latter growths, except that it may be possible to enucleate them without removing either the uterus or ovary.

Cysts.—These are very important, not only from their growth frequently demanding surgical interference, but also from their great pathological interest.

Causes.—These are as obscure as are those which produce ovarian cysts. The great majority, if not all, probably receive their first impetus from the congestions and inflammations to which the ligaments are exposed.

Pathology.—There are several varieties of broad ligament cysts.

1. *Cysts arising from distension of pre-existing structures.*—The hydatid of Morgagni, found as a small, clear cyst depending from one of the fimbriæ of the Fallopian tube, arises from the remains of Müller's duct. A similar small cyst, which may be either sessile or pediculate, is frequently found at the outer end of the horizontal tubule of the parovarium. Small cysts also grow frequently from the vertical tubules of the parovarium, and these, with the sessile variety from the horizontal tube, may attain considerable size and require surgical treatment.

2. *Cysts arising in the cellular tissue, possibly due to blocking and distension of lymphatics, but not arising in definite pre-existing structures.*—These are the simple serous cysts of the broad ligament, and are identical with the sub-peritoneal cysts in other situations, often spoken of as 'inflammatory cysts of the peritoneum.' They may be unilocular, multilocular, or multiple. The unilocular may be so from its earliest growth, or may become so from coalescence of multilocular or multiple cysts. The latter may be found side by side, but quite independent, so that each is really a unilocular cyst. The part of the broad ligament between the ovary and uterus is liable to a general cystic degeneration, apparently the result of œdema; it is not a condition of much practical importance, except in so far as it sometimes interferes with the application of the ligatures in the removal of ovarian or uterine tumours.

3. *Papilloma-bearing cysts.*—These are of great importance, because the possibility of the presence of such growth in any broad ligament cyst governs the whole surgical treatment of these cysts. Doran has recently thrown much light upon the origin of these cysts, and has shown that they commonly arise from the vertical tubules of the parovarium, and especially where these tubules penetrate deeply into the hilum of the ovary. It is still, however, an undecided question whether papilloma is only found in cysts with this origin, or whether it may arise from the lining membrane of any cyst. And it is equally uncertain why one kind of papilloma-bearing cyst produces an innocent warty growth, which, though it may spread and infect other surfaces, often dies away entirely after a successful removal of its parent cyst, and another form is distinctly malignant. The hard, white, warty papilloma is commonly found in these parovarian and hilum cysts from their earliest growth; but the more fleshy pink papilloma appears in flat patches

on the lining membrane of cysts which have been allowed to remain undisturbed for long periods, or have been repeatedly tapped. Possibly in this difference as to the time of their first appearance may ultimately be found the reason of their clear clinical divergence.

The cysts which arise at the terminal ends of ducts, and the simple serous cysts have a simple lining of flat endothelium, and their fluid contents vary in colour from pale straw to orange and dark coffee colour, the latter being due to the admixture of blood. The ordinary parovarian cysts, and those which contain the warty papilloma, have a clear limpid fluid like water.

Diagnosis and Treatment.—An imperfect knowledge of these broad ligament cysts has led to two considerable errors as to their diagnosis and treatment. The first of these is the common one of speaking of the whole class as parovarian cysts, whereas the simple serous cysts are commoner than the true parovarian; the second is the commonly received opinion that they all may be cured by simple tapping. There are probably two causes for this second error: first, the fact that any of these cysts may fill very slowly after tapping, and, in the long interval, pass altogether out of the knowledge of the surgeon who performed the operation; and, secondly, that simple serous cysts are occasionally cured by a single tapping.

The only points which aid the diagnosis of these cysts from those of the ovary are their slow growth and occasional flaccidity, or this latter condition alternating with a more tense one. As it is impossible to be absolutely certain whether any given cyst is a simple serous one, or contains the infecting papilloma, they should never be tapped either for diagnostic purposes by examination of the fluid, or with a view to possible cure. They are generally free from adhesions, and can be removed with but little risk. Occasionally a broad base may necessitate a difficult enucleation, but these cases also do remarkably well, if care be taken to check all hæmorrhage, and the sides of the capsule be allowed simply to fall together at the bottom of the pelvis—i.e. if the operation be thoroughly aseptic; if it be not so, a glass drainage-tube should be left in the capsule for the first day or two, as there is often a good deal of serum effused from its torn cellular tissue.

It is sometimes possible to remove the cyst and leave the ovary and tube; but this is rarely advisable, as both are apt to be altered by the stretching during the growth of the cyst, and are liable to become diseased. The preparation of the patient, the arrangements for the operation, the instruments required, and the treatment after operation, are in nowise different from those for Ovariotomy, and will be found described in detail in the article on that operation. J. Knowsley Thornton.

BROMIDROSIS.—*Syn.*: Osmidrosis; stinking sweat.—A functional disturbance of the sweat-glands, causing the sweat to be so altered in character as to give rise to an abnormal odour. It is sometimes accompanied by hyperidrosis.

Symptoms.—The condition may involve the whole of the surface, or be of a local character. When universal, the individual emits with perspiration an odour which may be like that of a goat, or like that of onions or assafœtida, or it may be simply disgusting and indescribable. Sometimes a rather pleasant odour is noticed, like that of violets.

Bromidrosis is frequently the accompaniment of systemic diseases—smallpox, typhus, rheumatism, pyæmia.

The local varieties of bromidrosis are met with chiefly in the parts which sweat freely—the axillæ, groins, perineum, genitals, soles of the feet; here it is probable that decomposition of the sweat and sebaceous secretion is mainly instrumental in producing the result. The confinement of the sweat by waterproof clothing, dress-preservers, &c., tends to make matters worse. Bromidrosis of the feet is that form which most often calls for treatment. When associated with hyperidrosis, the treatment by Hebra's ung. diachyli, described under Hyperidrosis, may be adopted.

A mode of treatment has been suggested by Thin which seems to be very efficacious. It consists in soaking the stockings or socks every night in a saturated solution of boracic acid. Cork soles should be worn in the boots, and treated in a similar manner.

A solution of chloral to bathe the feet, 10 to 40 grains to the ounce, is also recommended. Alfred Sangster.

BROMINE. *See* Caustics.

BRONCHOCELE. *See* Thyroid Gland, Diseases of the.

BRONCHOTOMY. *See* Tracheotomy.

BRUISES or CONTUSIONS.—These result from injury to the tissues caused by blows or squeezes. Structures may thus be so damaged as entirely to lose their vitality, so that sloughing or gangrene results. It much more commonly happens that the injury is of a less severe nature, being confined to the rupture of some small superficial vessels, leading to an extravasation of blood. The slighter cases are only here considered, the severer ones being found under the heading of gangrene. The blood oozing out from the ruptured vessels finds its way into the interstices of the connective tissue, both of the skin and subcutaneous fascia. In addition to the blood there is considerable effusion of serum stained with the colouring-matter of the corpuscles. Soon after the receipt of the injury the part becomes swollen, and assumes a semi-transparent, pinkish appearance.

Occasionally, after a while, large bullæ are formed beneath the cuticle, containing blood-stained fluid. As the serum is reabsorbed the swelling decreases, but the colour of the part becomes darker, passing, in the course of a few days, from a dull red to a dark brown or chocolate, and then, slowly fading away, it assumes a greenish-yellow colour. The extravasation of blood generally ceases to extend after a few minutes; sometimes, however, the effusion slowly continues for some hours, extending over an area considerably larger than the part actually injured. The bruised part may inflame, giving rise to suppuration; but this is rarely the case, unless the skin has been broken, thus making a compound contusion.

In some instances, instead of the blood forming an infiltration into the connective tissue, it forms a circumscribed collection beneath the skin. This is known as a hæmatoma. The contained blood does not coagulate, so that a soft fluctuating swelling results. The tendency to the formation of bruises or blood-extravasations varies widely in different individuals, and the extent of the discoloration is no certain indication of the amount of violence employed. Some persons with thin, delicate skins, or with a tendency to the hæmorrhagic diathesis, will have their tissues bruised and discoloured from the most trifling injuries, a fact which should be borne in mind in certain medicolegal enquiries.

Treatment.—This should be of the simplest kind. To suppose that the effects of a contusion can be at once removed by the application of stimulating or any other lotion is absurd, for time is required for nature to absorb the extravasated blood and repair the injured tissue. Irritating lotions, and either very hot or cold applications are especially injurious, for it must be remembered that the vitality of the skin is already lowered, and it will be liable to slough, or become gangrenous if subjected to irritation. Just at first, whilst there is a tendency for the swelling and extravasation to increase, cold fomentation or spirit lotion may be advantageously employed; afterwards, the part should be kept warm and protected from pressure. With this object it may be lightly covered with cotton wool, and kept in position with a flannel bandage. Should blebs form, they may be pricked, and a piece of oiled lint applied beneath the cotton wool.

Arnica lotion has enjoyed some reputation in removing the discoloration; possibly, by stimulating the blood-supply, it may occasionally have this effect, but it generally does more harm than good, often producing excoriations and eczema.

Should the damaged skin slough, a light poultice may be applied, to protect the injured part and hasten its separation. If the extravasation should take the form of hæmatoma, this may be treated by moderate pressure applied with a bandage. Under this treatment, the collected blood frequently becomes reabsorbed. Should it not do so after some weeks, the swelling, with antiseptic precautions, may be aspirated.

Harrison Cripps.

BRUSH-BURN.—This name has been given to a peculiar and complex injury caused by rapid and forcible friction of the surface of the body. It may be produced either by some rapidly revolving body, as a strap connected with machinery, coming in contact with the skin, or by the surfaces of the trunk and limbs gliding with much velocity down a long descent, such as an Alpine snow-slope. The skin is abraded, much bruised, separated from the subjacent soft parts, and sometimes actually burnt by the action of the heat developed by the friction. The subcutaneous connective tissue and the fasciæ and muscles are often much contused. In consequence sometimes of the burning, but more frequently of the cutting-off of its blood-supply, the injured portion of skin becomes gangrenous and is converted into a slough. The injury when extensive is a very painful one and attended with much collapse.

The treatment should consist in applying anodyne fomentations over the contused skin and, if this undergo sloughing, in dressing the eschar frequently with some stimulating lotion or ointment. The granulating surface exposed on separation of the eschar is to be dealt with in the same way as any large healthy ulcer.

W. Johnson Smith.

BRYANT'S SPLINT, for excision of the hip and fractures of the thigh, is a compound of two long splints, one for each lower limb, fixed together at the upper and lower ends—at the upper by an iron bar which arches across the chest, and at the lower by an iron rod which passes straight across below the foot-pieces. The foot-pieces slide in slots at the lower end of the splints, and to each is attached a cord passing over a pulley, by means of which it is directed along the outer side of the splint, where it is attached to an elastic accumulator. By means of a piece of wood with a hole at each end, similar to those used for tightening tent-ropes, which is placed on the cord, it is possible to put the accumulator on the stretch and so cause traction on the foot-piece, and the use of the double splint is thought to ensure perfect symmetry of the two limbs. BILTON POLLARD.

BUBO.—A bubo, in the original use of the word, was any glandular swelling occurring in the groin. The term has, however, been extended to include gland-swellings in other parts, and it has been restricted to those which are secondary to sores existing elsewhere. Conventionally, a further limitation is often made, and we employ the word to denote only gland-enlargements which are secondary to venereal sores. In popular use, and probably with nine-tenths of the profession, the word now has only the latter meaning, and it might avoid confusion if it were in the future so restricted. The classical 'buboes of the plague' will probably long retain their name, but it is rapidly becoming pedantic to call enlarged glands 'buboes,' unless we mean that they are due to venereal disease.

The character of the venereal bubo is determined by the nature of the sore itself. If the latter be inflamed and suppurating the bubo will probably partake of the same features; the glands will swell largely and the cellular tissue around them will be implicated. Thus the glands will be glued together, and an ill-circumscribed painful mass will result. Such buboes have a tendency to suppurate. The matter frequently forms first around the inflamed glands but not in them, and the latter may be laid bare by the destruction of the intervening tissue. In other cases, however, suppuration undoubtedly takes place in the glands themselves, which, one after the other, may soften and break down. Individuals differ very much as regards their liability to lymphatic implication, but with our modern improvements in the treatment of chancre and of syphilis we may now boast that suppurating buboes are very rarely seen. They occur for the most part when the primary sore has been neglected.

If the primary sore be indurated and not inflamed, then we must expect induration only of the affected glands. The hardening will probably implicate several of them, but it will not involve the intervening cellular tissue. The glands will remain isolated from each other, and will be probably scarcely at all painful. They may be rounded and very hard—the 'bullet bubo'—or elongated and only moderately firm—the 'amygdaloid bubo.' In the case of the infective chancre it is rare to have the glands inflame and suppurate, and this never occurs unless the sore has itself inflamed. It is said that when suppuration occurs in a bubo consequent on an infecting sore, the pus is not contagious, but it is obviously not possible that we should possess much knowledge on this point. The induration of the glands consequent on the infecting sore is often very prolonged, and lasts, in a minor degree, long after other symptoms of syphilis have disappeared. It has been suggested that in such cases the glands serve as reservoirs for the virus and take an important share in the production of relapses. Although this is mere conjecture, yet it may be fully admitted that it is a wise precaution to continue treatment until the gland-enlargements have quite disappeared. It must be remembered, however, that a certain degree of enlargement of the glands in the groin is the normal condition with some persons.

Occasionally, at long intervals—a year or even more—after the primary sore, glands which were at the time slightly enlarged, will take on fresh engorgement and suppurate. In these cases the buboes are in part of constitutional origin, and further mercurial treatment is generally required.

Although it is certain that the bubo in connection with an indurated chancre will occasionally suppurate, yet this is very exceptional. It occurs solely when the chancre is on the genitals and the bubo in the groin. In the case of erratic chancres, as on the lip from kissing, or on the finger from inoculation in midwifery practice, although the gland-enlargement may be very considerable, it very seldom, or perhaps never, ends in abscess. In the groin the glands are very superficially placed, and are especially liable to be bruised or irritated by external causes, and hence probably the increased risk of abscess there.

The *treatment* of the bullet bubo of the infective chancre resolves itself into the treatment of syphilis. Mercury must be freely given and cannot be begun too soon. The patient must be told to carry nothing in his trousers' pockets, and if the glands are more than usually large, he must not walk much. The treatment of the bubo which attends the non-infecting sore is a matter of much more difficulty. The main point is of course the treatment of the sore itself. This must be rendered healthy as soon as possible. Next, every possible cause of external irritation must be carefully avoided and rest enjoined. Since the tendency to suppuration is often a constitutional matter, the patient's health must be sustained by tonics and a liberal diet, or in critical cases by sea air. To the groin it may be well, so long as there is hope of repression, to use ice or evaporating lotions very freely, but in many cases warmth will be attended by better results. A hot poultice, by relieving pain and tension, will often favour the subsidence of inflammation, whilst if suppuration have occurred it will hasten its progress towards the surface. If, therefore, suppuration appear inevitable, it is better to poultice at once. The question will now arise as to the propriety of excising the affected glands. If they are large and isolated, or if they have been exposed by suppuration around them, it is certainly good practice to give an anæsthetic and to proceed systematically to their removal. If they are left they will often be very slow to subside and may give much trouble. Their enucleation, however, is by no means always an easy matter, and it is indeed seldom practicable to make the operation a complete one. It is always, however, well in opening a bubo to make the incision a free one and to scrape away as much of the gland implicated as possible. Sometimes the glands within the brim of the pelvis are also enlarged. In such cases sea air and the free use of tonics in combination with mercury are indicated.

As regards the precise position of the glands implicated, this is to be explained entirely by anatomical knowledge. It is to be remembered, however, that the lymphatics inosculate freely and are by no means always regular in their course. We must, therefore, allow for buboes which appear to deviate somewhat from rule. Thus a sore on the right side of the glans penis may produce a bubo in the left groin, or *vice versâ*, because the lymphatics often cross in the dorsum of the penis.

The term 'double bubo' is used when the gland-enlargement is on both sides. That of 'bubon d'emblée,' or primary bubo, is applied to cases in which a bubo appears without any chancre being discovered. A 'sympathetic' bubo is a misnomer for a gland-enlargement which is supposed not to be in direct connection with the peripheral cause, i.e. not due to absorption. As a matter of fact all true buboes are due to absorption of some kind. The terms acute, indolent, indurated, constitutional, &c., as applied to buboes, sufficiently explain themselves.

In certain constitutions it is quite possible for a bubo to arise from common non-specific balanitis. So also we occasionally have buboes in connection with gonorrhœa. In such cases the general rules of treatment will be the same as for those which occur in connection with non-indurated sores.

Jonathan Hutchinson.

BUBON D'EMBLÉE. — A term implying 'primary' or 'non-consecutive' bubo, was given formerly, by some French writers on syphilis, to a supposed form of suppurating bubo with inoculable secretion, arising quite independently of any primary venereal or syphilitic sore, and followed by manifestations of general syphilis. The existence of such a lesion as this is now almost universally denied, as it is opposed to the widely-accepted views that the syphilitic virus never penetrates an unbroken surface, and that the suppurating bubo with inoculable discharge is always associated with a non-infecting sore, and never in itself causes constitutional infection.

BUBONOCELE.—This term, now seldom used, has been applied to an oblique inguinal hernia whilst still retained within the inguinal canal.

BUCHANAN'S RECTANGULAR STAFF.—This staff, bent at right angles three inches from the point and deeply grooved along the short limb, was devised by Dr. Buchanan, of Glasgow, for use in his modification of median lithotomy. With this staff, it is held, the prostate may be reached by the knife more readily and rapidly, the membranous portion of the urethra need not be wounded, and there is less risk of injuring the rectum. The rectangular staff having been introduced, and its angle corresponding in position with the apex of the prostate being made to project into the perineum, a long and narrow knife with a straight blade is thrust along the groove in the short limb as far as the interior of the bladder, the rectum being protected by the forefinger of the left hand. The wound in the prostate is enlarged in an outward and downward direction as the knife is withdrawn.

BULLÆ or BLEBS, are blister-like elevations of the epidermis, varying in size from a split pea to half a turkey's egg, and containing fluid. In recently formed blebs the fluid contained is usually serous and of a clear pale straw colour; later on it becomes turbid, and sometimes dark red from the admixture of blood, or thick and yellow from the formation of pus. The fluid is always albuminous and generally alkaline in its reaction. Good examples of blebs are met with in pemphigus, and they may be artificially produced by the application of powerful irritants, such as cantharides or boiling water, to the skin.

Robert Liveing.

BUNION.—This term is applied to the enlarged and thickened bursa often met with over the inner side of the metatarso-phalangeal joint of the great toe, in consequence of the distortion which takes place there. By the constant wearing of narrow-pointed and short boots the toes, especially in women, are crumpled together, and the pressure on the inner side has the effect of dislocating outwards the two phalanges of the great toe. As these are driven outwards under or over the second or third toes, the head of the first metatarsal bone forms an increasing projection, and enlargement of the bursa naturally met with there takes place. *Pari passu*, the head of the metatarsal bone itself gradually enlarges, and presents small bony outgrowths similar to those met with in joints the site of osteo-arthritis; the cartilage is absorbed, and the underlying bone becomes eburnated and sclerosed, the internal lateral ligament being elongated, while the external lateral is much shortened.

The chief troubles resulting from bunion are, first, the recurrent attacks of inflammation of the bursa, which cripple the patient while they last. After a while suppuration takes place, and the bursa, discharging, is liable to leave an ulcer, the healing of which is most tedious, owing to the liability to irritation, and the feeble circulation often met with after middle life, the period at which bunion comes chiefly under the notice of the practitioner.

Inflamed bunion, and still more the ulcer resulting from one which has suppurated, is very liable to render the patient subject to recurrent attacks of cellulitis and erysipelas, or even to become the starting-point of senile gangrene in aged or broken-down patients. If the ulcer open into the joint one variety of 'perforating ulcer' will present itself, leading to disorganisation of the joint and caries of the bones which enter into it.

Treatment.—One of the first things for the practitioner to insist on, a step which will, of itself, give sufficient relief in the early stages, is the wearing of proper boots, with straight inside border, rounded toes, giving sufficient room and play for the foot. The patient may be instructed to draw the phalanges inwards by passing a piece of Leslie's strapping between the first and second toes, around the phalanges of the first, and then carrying it along the inner border of the foot and round the heel as far as the centre of the outer side, this strip being secured by some others passed transversely round the foot and a bandage. A pledget of cotton-wool or 'elephant plaster' should be worn between the first two toes. Dr. Sayre recommends the use of a glove of buckskin or linen; this is fitted over the phalanges, and a few inches of elastic webbing attached to it, this webbing being itself fastened to a piece of strapping which goes round the heel, and is kept *in situ* as explained above.

If the case is too advanced for such simple treatment, some mechanical contrivance must be made use of. This consists of a metal sole-plate, which carries a delicate steel spring, by which the everted phalanges are gradually drawn inwards. Crumpled or hammer toes may at the same time be straightened by bandaging them with tapes to the sole-plate through slots in it. More conveniently worn than the above is the bunion-spring, made by various instrument-makers. The above should be worn by night as well as day. Where the phalanges are found too set or stiff to yield to gradual mechanical replacement, the surgeon may follow one of two courses. Aided by an anæsthetic, and with strict antiseptic precautions, he may divide the shortened external lateral ligament and any tendons, such as the extensor longus, which require it, and then forcibly but steadily replace the phalanges. If this be done too quickly the contracted skin on the outer side will very likely give way. Another, and probably better course is to perform osteotomy of the first phalanx, and thus bring the line of the great toe straight. But, in most cases of disorganisation of the joint, amputation by the oval method will be the wiser course, care being taken to secure ample flaps, and not to disturb the head of the metatarsal bone or the sesamoid bones, if sound.

The bunion itself will require various treatment, according to its stages and condition. When simple thickening of the bursa or effusion into it exist, counter-irritation by flying blisters, iodine, nitrate of silver (ʒj. to f℥j.), strapping with Scott's ointment or the oleate of mercury, may be tried. When the bursa is inflamed, lead lotion, conium, and bread poultices are indicated, together with the frequent and prolonged use of hot foot-baths, the treatment above given for the more chronic stage being later on resorted to. Where suppuration takes place an incision should be made early, otherwise the patient incurs the dangers of erysipelas, cellulitis, and troublesome burrowing. Furthermore, the ulceration which results from a suppurating bunion is, at this time of life, most tedious. Any undermined skin is to be snipped away, the cavity of the bursa laid freely open, and obliteration by granulations encouraged by absolute cleanliness and stimulating applications. With these objects in view, Ol. acidi carbolici (1 in 40), an ointment containing ʒj. of iodoform and eucalyptus oil to ℥j. of vaseline, and, later, more stimulating ones of Ung. resinæ and Tr. benzoini co., or Hyd. biniodi gr. x. to vaseline ℥j. (T. Smith), may be made use of. The weak circulation should be encouraged by warmth and elevation, and the healing promoted by occasional applications of weak nitrate of silver lotions to the granulations, which often become stationary for a while. Skin-grafting may, in some cases, be resorted to with benefit. In patients advanced in life small doses of opium will often be found beneficial, and in these cases warmth by means of cotton-wool, as little exposure as possible, and the raised position, are points of cardinal importance.

W. H. A. Jacobson.

BURNS.—Under this heading it is proposed to include all lesions that may be caused by the prolonged action of caloric on the surface of the body, and by the direct application to the living tissues of flame, steam, and intensely heated bodies, whether in a solid or fluid form. The injuries produced by the chemical action of caustics, and those known as lightning-strokes, will be dealt with in separate articles. *See* Lightning, Accidents from; Caustics.

The term *Scald* is popularly applied to such injuries from caloric as are caused by heated fluids or steam. Between such injuries, however, and those caused by flame or heated solid bodies, no distinction can be made with regard to the nature of the changes produced in the tissues, or to their results and treatment.

The causes of burns and the ways in which caloric is applied to the body so as to produce injury vary much at different periods and in different countries, according to the habits and pursuits of the working classes of each people. The most frequent causes in this country are: the action of flame, the contact—more or less prolonged—of intensely heated solid bodies and fluids, and of fused metals, explosions of gas, and the impact of steam. In the United States and some parts of Germany burns are caused, in many instances, by the ignited vapour of certain mineral oils.

The injuries produced by the action of flame and highly-heated solid bodies are usually deep and destructive, whilst, in severe cases of scalding by heated water or steam, the gravity of the injury depends generally rather on the extent of surface involved than on the depth of the disorganisation. Scalds, however, that are caused by thick, oily, gummy, and saccharine fluids which adhere to the surface of the skin, and by boiling saline solutions are, as a rule, very destructive. The injuries caused by steam in 'boiler explosions' are usually very serious, in consequence of the extent of surface that is attacked, and of scalding of the mucous membrane of the respiratory tract. Of the more frequent forms of injuries from caloric, the most dangerous are those produced by the flame of burning clothes and by ignited gas. Rapid and deep disorganisation is the usual result of the contact of red-hot and fused metals, and of phosphorus and sulphur in a state of ignition; but injuries of this kind are usually confined to a small extent of the surface of the body. The least severe of burns, with regard to both extent of surface and degree of disorganisation are those caused by the action of radiated heat.

Of the many classifications of burns that have been proposed, chiefly by French surgeons, since the beginning of the seventeenth century, the most approved, and clearly the most convenient, are those of Boyer and Dupuytren. The arrangement of Boyer, which has been adopted by most German surgeons, is strictly a pathological one. It divides burns into three degrees, according to the conditions of redness, vesication, and destruction of tissue, these conditions corresponding to the three processes of *hyper-*

æmia, *inflammation*, and *mortification*. In the frequently cited classification of Dupuytren, burns are arranged on a histological basis, in six degrees. The first of these is characterised by erythema or superficial phlogosis of the skin, and the second degree by cutaneous inflammation with elevation of the epidermis and development of vesicles filled by serous fluid; in the third degree, there is destruction of some portion, not the whole, of the thickness of the papillary body; in the fourth degree, disorganisation of the whole of the dermis down to the subcutaneous connective tissue; in the fifth degree, destruction of all the superficial parts, and more or less of the muscular layer; and, in the sixth and last degree, 'carbonization' of the whole thickness of a limb.

Burns will be classified here in three degrees: the first, of congestion; the second, of vesication; the third, of more or less disorganisation of soft parts.

The lesion of the first degree is one of simple scorching. The burnt surface presents an erythematous redness, which disappears readily on digital pressure. The intensity of this redness varies in different cases, and the borders of the rash are ill-defined. The skin is dry and slightly swollen, and the patient suffers from a diffused burning pain which, though sometimes severe, is never so intolerable as in the second and third degrees. In mild cases the redness and pain disappear in the course of a few hours, but in most instances requiring surgical treatment, the pain declines very gradually, the epidermis desquamates, and the surface of the skin remains discoloured for many days. Simple burns of the first degree are most commonly caused by radiated heat, by a very temporary application of the flame of conflagrated gas, or of some inflammable vapour, or by the contact of a solid body or of some fluid moderately heated. This is probably the only form of burn which may exist on the surface of the body unaccompanied by any of the characteristic lesions of one or more of the other degrees, whereas in some severe burns the main lesion, whether it be vesication, or eschar, or deeply reaching slough, is always surrounded by a zone of reddened and hyperæmic skin. In the majority of cases of burn of the first degree the prognosis is very favourable, the injury being a mild one, and needing scarcely any treatment save the application of cold. But following the law that the severity of a burn depends more on the extent than on the depth of soft parts involved, the simple hyperæmic form contributes a very dangerous lesion when spread over a considerable surface. It has been asserted that a burn of the first degree, when it involves two-thirds or more of the surface of the body, will inevitably prove fatal. According to Dupuytren, when the head is the seat of a burn of this, as of any other degree, the irritation may extend to the brain and cause insomnia, delirium, convulsions, and even fatal coma. In a person having a very delicate skin, exposure to the rays of a bright sun, whether transmitted directly or reflected from some extensive white or glistening surface, will often cause intense and painful scorching, which may result in a sharp attack of erysipelatous inflammation.

In a burn of the second degree, the skin is marked by one or, usually, several patches of erythema, each of which is studded with numerous bullæ containing clear and yellow serous fluid. These bullæ vary much in size in different cases and in different parts of an extensive burn. In some instances the vesicles are very small, whilst in the more severe cases an extremity—as the foot or hand—may be covered by one large blister. In this degree there is always pain, which at first is very severe, and, subsequently, as vesicles appear and enlarge, becomes dull and heavy. In the most favourable cases the heat and redness of the surface subside speedily, the vesicles burst and discharge their fluid, and, as the dry and shrivelled epidermis is thrown off, a smooth surface is left which, in the course of a few days, presents the usual appearance of sound skin. If, however, the vesicles be prematurely ruptured and the elevated epidermis be torn away, or if the patient be feeble, the burnt surface may become inflamed, and suppuration and also some superficial sloughing may result. But even in the most prolonged and severe cases, if the burn be one strictly of the second degree, the epidermis will almost always be restored and permanent scars will very rarely be observed. It is often very difficult, however, to determine whether a vesicating burn be a well-marked form of the second degree or a mild form of the third degree; for, as has been pointed out by Billroth, there are many grades between elevation of the horny layer of the epidermis and complete destruction of the cutis.

The characteristic lesions of the second degree are observed most frequently in scalds, and after a very transient application of heated metal. They are, in the primary stage of the burn, more painful than those of any other degree. When much of the surface of the body is involved, especially the front of the chest and abdomen, they are very serious, and in cases of almost complete immersion of the body in some highly heated fluid, are speedily fatal.

In the mildest burns of the third degree, besides the epidermis, a portion also of the thickness of the cutis is destroyed. This degree is characterised by the presence of yellow, grey, or dark-brown sloughs, which in some instances are soft and moist, in others tough and desiccated. These patches are occasionally associated with vesicles containing a turbid and often blood-stained fluid. The disorganised portion of skin is surrounded by a broad zone of erythema, dotted over by small vesicles, such as are met with in the second degree. As was pointed out by Sir Robert Christison, in the more severe burns of this degree, caused during life, the patch of destroyed skin is surrounded by a narrow band of a deep red colour, due to extravasation of blood or very minute capillary injection, which narrow band is separated from the charred part by a stripe of dead-whiteness, and passes at its outer edge by insensible degrees into a diffused blush, involving a considerable extent of the surface around the centre of the burn. It has been proved by experiment that the application of heat to the body, even a few minutes only after death, fails to produce any sign of this reaction. In favourable cases of burn of the third degree the sloughs gradually separate from the living parts, and during or soon after the third week are usually thrown off, leaving the well-known yellowish-white or pale grey surface, thickly studded with bright red points. This surface, after the removal of all dead and foreign material, heals rapidly by the formation of a thin, smooth, and white scar. This scar, though it can never be effaced, is always freely movable over the subjacent parts, and in consequence of its tenuity, and the presence beneath it of healthy cutis, does not tend by retraction to cause any tension or distortion of the surrounding parts.

A more severe burn of the third degree consists in destruction of the epidermis, of the whole thickness of the cutis, and of more or less of the subcutaneous layer of connective tissue. As a rule, however, in burns causing destruction of skin, the surgeon at first is unable to determine the depth to which the disorganisation has been carried, and often finds it difficult to distinguish at first sight a burn of this kind from a severe one of the former kind, or from a relatively mild one of that in which muscle, in addition to skin and connective tissue, has been involved. Again, with regard to prognosis as to the risk of subsequent cicatricial deformity, it is possible that, in the progress of any case of severe burn, excessive inflammatory action and consequent sloughing may cause still deeper destruction of the soft parts, so that in its anatomical conditions a burn of merely the cutis may be converted into one of the whole skin and of subjacent cellular tissue. The importance of the distinction between burns of the third and of the fourth degrees, in Dupuytren's classification, consists mainly in the manner in which the latter heal and in the structure and properties of the resulting cicatrices. In every burn causing disorganisation of the whole cutis, and more or less of the subjacent connective tissue, the open surface heals partly by the formation of dense and very retractile cicatricial tissue, partly by stretching and centripetal displacement of the surrounding skin; and thus it is only in burns which are deep and extensive that the healing is likely to result in the well-known deformity. Great stress has been laid by some authors on much-reduced sensibility as a distinguishing characteristic of burns of the third degree, as compared with those of the two former degrees. The eschars formed by the disorganisation of skin are certainly quite painless, but usually the patient suffers very much at the time the injury is received, and again after the separation of the dead parts and on the exposure of very sensitive granulating surfaces. Besides, as has already been stated, in extensive burns the lesions of two or more degrees are almost always found side by side, the charred surface being surrounded by blisters and a broad zone of hyperæmic and tender skin.

The most frequent causes of burns of the third degree are the action of the flame of burning clothes, and the prolonged application of heated metals and other solid bodies.

In its most severe form the burn has extended below the skin and cellular tissue and involved the muscular and other deep-seated soft parts of the injured region. In these burns, which are much less frequent than those of the preceding forms, a hard, dry, inodorous eschar of a deep brown or a black colour is formed, which on separating exposes fasciæ, muscles, and sometimes large vessels and nerves. In cases of this kind the detachment of the eschar may be followed by profuse bleeding. The deep ulcer formed by the destruction of so great a thickness of the soft parts, heals very slowly and with prolonged and exhausting suppuration.

In considering the general disturbances which may result from the action of concentrated caloric on the surface of the body, it will be found convenient to follow the course of a severe burn through the three stages of *prostration*, *reaction*, and *suppuration.*

The first stage, that of prostration or congestion, lasts from eighteen to twenty-four hours. The most prominent symptom is pain, which varies in its intensity according to the extent of the burnt surface and the degree of the burn. In extensive injuries of the second degree, such as scalds caused by the action of boiling water or steam on a considerable surface of the body, the agony is very great, and, according to Dupuytren, may by itself cause death. The suffering in cases of this kind is often increased through careless removal of the patient's clothes, so that the vesicles are ruptured and the elevated epidermis torn away, leaving large patches of denuded cutis. The general condition, in the first stage of a severe burn, is one either of deep collapse or of extreme restlessness and excitement. The patient often complains of alternate fits of general heat and chilliness. Death often occurs in this stage from shock, the patient either sinking rapidly without the least sign of a rally, or yielding to gradually increasing prostration, after muttering delirium, slight convulsions, and perhaps vomiting, at last succumbs. In children the more common fatal symptoms are convulsions and coma. In the stage of prostration, particularly in cases of very extensive burns of the second or third degree, extreme and obstinate thirst is a frequent symptom. It was pointed out by Nélaton, that many of the subjects of extensive burns complain soon after the injury of a very urgent desire to micturate, although the bladder may be quite empty.

The duration of the second period, which begins with reaction, varies much according to the degree and extent of the burn. In mild injuries of the first and second degrees this period is brief, lasting only for two or three days, but in severe burns of the third degree it does not pass into the final stage until the sloughs have separated and suppuration has become established. Most authors consider two weeks as the average duration of the period of inflammatory reaction. During this period the pain caused by vesicating burns of the second degree gradually diminishes, whilst the subjects of more severe burns in which the cutis has been destroyed, suffer much just before and during the separation of the sloughs. The patient is usually feverish during the early part of this stage, but there is rarely persistent fever or a very high temperature, save when the burn is severe and complicated in its course with local irritation or visceral inflammation. In severe burns involving the surface of the chest, cough is a frequent symptom during this period, and indicates some thoracic complication, as congestion of the lungs, pleurisy, or broncho-pneumonia. The most frequent and troublesome symptoms are vomiting and diarrhœa. The former, when obstinate and associated with the presence of blood in the stools, is suggestive of ulceration of the duodenum. During separation of any large and deep sloughs there may be serious loss of blood, which, in most instances, is due rather to oozing from several small vessels than to free arterial hæmorrhage from one point.

The third period, that of suppuration and exhaustion, lasts from the separation of the sloughs to the healing of the exposed granulating surfaces. The principal symptoms of this period are those due to exhaustion from profuse discharge. The patient, if the burn be wide and deep, may suffer now from hectic fever and marasmus, and be attacked at any time by any of the general or local complications of a large, open and suppurating wound; such, for instance, as erysipelas, cellulitis, sloughing, and diphtheria of the granulating surface, pyæmia and septicæmia, and tetanus. The more special internal complications which may occur during the third period are asthenic inflammation of the lungs and duodenal ulceration. In children convulsions may occur at any time in the course of the suppurating stage of a large burn.

Although the prognosis is much influenced by the degree of a burn, the superficial extent of the lesion is a more important element than its depth. As has already been stated, a very extensive burn of the second, or even of the first degree, is much more serious than a deep burn involving but a small portion of skin. With regard to cicatricial deformity, the more severe burns of the third degree are to be regarded as serious, especially when they are situated on the face, the flexure surface of a limb, the front of the neck, or on the hand. Scalds of the face and mouth are of serious import, as indicating a very probable complication of œdema of the glottis. Burns of the scalp, even when slight, are always liable to be complicated with erysipelas, and extensive burns of the front of the chest very often give rise to inflammation of the lungs or pleura. Burns are more fatal in young children and in old people than in adults, in consequence of the susceptibility to pain and nervous irritation in the former, and of the feeble resistance, in the latter, to the exhausting effects of suppuration during the third stage. Moreover, children are very liable to be attacked by acute inflammation of the lungs or encephalon, whilst old people are seriously affected by any relatively slight complication, by exposure to cold, or any sudden change in the weather.

Of the fatal cases of burn it may be roughly stated that fifty per cent. terminate during the period of shock, thirty per cent. during the period of reaction, and twenty per cent. during the period of suppuration.

There is much variety in the modes of death from burn. Early death, when the injury is severe, is usually due to shock, the patient presenting a general condition similar to that observed after a suddenly produced contusion or laceration of a limb, or a violent injury to the abdomen. In many cases of fatal burn the condition of collapse is doubtless rendered more intense by mental emotion and terror, and also by acute pain, although it may be questioned whether pain *per se* can, as Dupuytren suggested, be the cause of death. In patients who, after having rallied to some extent from the immediate effect of the injury, yet die during the first period, death is usually the result of a condition characterised pathologically by congestion and commencing inflammation of the brain and its membranes, of the lungs and air-passages, and of the abdominal viscera. Dupuytren, who was one of the first to investigate and explain the general conditions which cause death after a burn, showed by post-mortem examinations that in subjects who have perished very soon after a severe burn or scald, and before internal inflammation has had time to develop itself, the brain is much injected with blood and the mucous membranes of the bronchi and intestinal canal are much congested. Moreover, not only are these mucous membranes swollen and studded with large patches of congestion, but the intestines contain effused blood and the bronchi are obstructed by blood-stained mucous fluid. After death, at a later stage—between the third and ninth days—the autopsy usually reveals all the indications of well-marked gastro-enteritis and often of inflammatory changes in the lungs. Dupuytren's statements have since been confirmed by the more extensive pathological investigations of Mr. Erichsen and Mr. Holmes. These surgeons have shown that, after death from burn during the first period, the brain and its membranes are almost always found congested, and the thoracic viscera and the gastro-intestinal mucous membrane very frequently so. After death during the second period, indications of cerebral congestion are still occasionally to be found, but the most frequent and characteristic pathological appearances are those of inflammation, and inflammatory congestion of the lungs and pleuræ, and of more or less congestion of the intestinal tract, frequently associated with ulceration of the duodenum.

Mr. Erichsen, in his observations of fatal burns, found that the brain was affected in thirty-three out of thirty-seven cases, the thoracic viscera in thirty out of forty, and the abdominal viscera in thirty-one out of forty-two cases.

Several views have been proposed to account for this almost constant tendency to visceral congestion and inflammation in cases of severe burn. In 1863, M. Baraduc, a French surgeon, brought forward the purely physical theory that, in consequence of the effusion of serum at the seat of the burn, the blood becomes thickened and plastic, so that it can no longer circulate freely. To this view there are strong and apparent objections. Except in cases of very extensive scalding, very little serum is effused on the surface of the body, and, as is well known, the blood may be deprived of large quantities of fluid, as in rapidly renewed ascites after tapping, without any evident bad result. A viscid condition of the blood after fatal burn has recently been found by Tapperner, of Munich, but as, in each of the four cases which were observed, the injury was very severe, and as much as two-thirds of the surface of the body was involved, death was very probably due rather to shock than to any undetermined result of loss of blood-plasma.

It has been suggested by Billroth that the visceral complications found in the early stages of burn may be due to an accumulation in the blood of nitrogenous compounds, retained as a result of wide destruction of the skin and consequent diminution of the cutaneous respiration. The subject of an extensive burn is, it is thought, placed in a condition somewhat similar to that of an animal completely enveloped in some impermeable material, which, after a time, presents symptoms of intense and fatal blood-poisoning. Well-marked, and even fatal, visceral congestion, however, is frequently observed when but a small extent of surface has been burnt.

Again, in the most extensive burn compatible in the human subject with vitality, there is always much sound skin left, and in burns of the first, and probably in most of those of the second degree, the cutaneous expiration is accelerated rather than obstructed.

Ponfick holds that in severe burns capillary embolism of internal organs is caused through a profound alteration and destruction of the red blood-corpuscles, and it is thought that the congestion of the lungs and the pneumonia so frequently observed in such cases of injury may have some connection with this blood-change. According to Falk, however, the theory that visceral inflammation is due to destruction of red blood-corpuscles in the vessels of the burnt part is not supported by a sufficient number of positive facts. Hoppe-Seyler, on microscopical examination of the blood in cases of severe burn, found the destructive changes in the corpuscles far too slight to give rise to any general disturbance.

It seems very probable that the visceral congestion so invariably associated with severe burn, is caused in great measure, as was argued by Brown-Séquard, by reflex action of the spinal cord; and that the visceral inflammations so frequently observed during the later stages of the treatment are the results either of septic poisoning or, with old and much enfeebled subjects, of prolonged confinement to bed and increased susceptibility to external influences.

There can be but little doubt that ulceration of the duodenum is an occasional result of burn on the surface of the body. Mr. Curling, in 1842, directed attention to twelve instances of this association, and Mr. Holmes found it recorded in 16 out of 125 miscellaneous fatal cases of burn. Simple or non-traumatic ulceration of the duodenum occurs much more frequently in males than in females, and is very rarely observed in patients below the age of puberty. Krauss found, on analysing 42 collected cases of simple ulcer, that the proportion of affected males to females was as 10 to 1, and that 2 per cent. only of the patients were under the age of ten years, and 6 per cent. under the age of twenty. Of 25 cases of intestinal ulceration associated with burn, that have been collected by the writer of this article, in 17, at least, the patients were females. In 6 out of the 25 cases the patients were under the age of five, and in 15 under the age of ten, and in one case only was the age above thirty. In most of these cases the burn had been severe, and had involved a large extent, usually the front of the neck, chest, and abdomen, and one limb or more. In three of these cases death occurred in the first week of the burn, in eight cases in the second week, in six cases in the third week, in a single case in the fourth week, and in two cases in the fifth week. In one case that has been recorded by Mr. Erichsen decided symptoms of intestinal ulceration were observed on the second day after the burn, and death occurred on the sixth day.

The duodenal ulceration is usually situated in the first and ascending portion of this intestine, and near the pylorus. The lesion, which is found most frequently on the front wall of the intestine, consists in one or, as generally happens, two or more small circular ulcers, or one large oval patch of ulceration formed by the junction of two ulcers. The margins of the ulcer are sharply cut, and the ulcerated surface is, as a rule, deeper in the centre than at the periphery, the inner coats of the intestine being destroyed over a greater extent than the serous coat. In acute cases the ulceration has a tendency to involve the whole thickness of the intestinal wall, in some cases extending to the surface of some neighbouring organ, as the pancreas, liver, or gall-bladder; in others, opening freely and directly into the peritoneal cavity, and giving rise to perforative peritonitis. Occasionally the progressive ulceration erodes some large vessel.

Duodenal ulceration is very probably caused, not, as Mr. Curling has suggested, by inflammation and ulceration of one or more of Brünner's glands, but by the action of the acid gastric juice on a patch of mucous membrane in which the circulation of the alkaline blood has been arrested through embolism. In support of this view it has been pointed out that a duodenal ulcer, whether simple or traumatic, has very rarely been observed below the orifice of the common bile-duct.

The diagnosis of duodenal ulcer in cases of burn is very obscure. In some instances it is indicated by epigastric pain, vomiting of dark brown fluid and diarrhœa, with occasional discharge of blood in the stools. In some recorded cases of this lesion, however, all these symptoms were absent, and no indications were observed until after death. If a large vessel has been opened there will be profuse melæna and hæmatemesis, and in cases of perforation symptoms of localised or general peritonitis. Ulcer of the duodenum, though a serious complication, is not universally fatal, as some few instances have been put on record, in which cicatrices of old ulceration were found in the intestine after death from some other or more indirect result of severe burn.

During the third period of a severe burn the patient is exposed to all the risks which attend profuse and exhausting suppuration. In young and feeble subjects the progress towards recovery may be interrupted from time to time by attacks of fever and prostration. The most fatal complication in this final period of suppuration is pleuro-pneumonia. Congestive affections of the abdominal and intracranial viscera are not so frequent in this as in the second period; but in a scrofulous child tubercular disease of the meninges or of the mesenteric glands may be developed during the slow healing of the burnt part. In the third period sudden death occasionally takes place from some obscure cause, which cannot be determined on careful post-mortem examination.

As casual causes of death in the course of the treatment of a severe burn may be mentioned: erysipelas, which is often met with in cases of burn of the scalp; cellulitis, which sometimes occurs in association with an extensive burn of the second degree in the second or third period; pyæmia, not, however, of frequent occurrence; and tetanus.

Treatment.—In the general treatment of a severe burn in its first stage, the main indications are to overcome shock, to relieve pain, to calm restlessness and agitation, and guard against coma. In dealing with intense collapse, the ordinary means for bringing about reaction should be applied. Blankets should be wrapped around the patient, hot-water bottles be placed at the feet and along the sides of the trunk, and brandy with hot water be frequently administered. The intense pain may be best relieved by a full dose of laudanum or liquor opii sedativus, or by a hypodermic injection of morphia. As reaction becomes established, it will be advisable to reduce gradually the supply of alcoholic stimulant, and to give frequently and in small quantities hot beef-tea or soup. If there be much thirst, the patient should take milk mixed with soda-water, weak lemon drink, or barley-water containing a small quantity of dilute sulphuric or phosphoric acid. During the course of the reaction, bromide of potassium may be administered every three or four hours if the patient complains much of pain.

In the second period it is necessary to support the strength of the patient, and to husband his forces, so that he may withstand the exhausting influences of the final period of suppuration. At the same time, however, undue stimulation should be avoided, and a careful watch be maintained for indications of visceral inflammation. The diet should be nourishing, but consist, as far as possible, of fluids—as milk, beef-tea, soup; and where there is a decided tendency to diarrhœa and vomiting, similar precautions in feeding should be taken to those observed in the management of a case of typhoid fever. Symptoms of pulmonary congestion and broncho-pneumonia are best treated, if the patient be not very weak, by liquor ammoniæ citratis and small doses of tartar-emetic; and diarrhœa should be treated by chalk and opium, or small doses of castor-oil and laudanum, or, if very obstinate, by sulphate of zinc and opium.

In the treatment, during the third period of a deep burn, of a large, open, and suppurating wound, it becomes necessary to support the patient's vital powers by giving a free and generous diet with wine and malt liquors; and to overcome, so far as may be convenient, the adverse influences of a long-occupied sick chamber by occasional changes of air and scene.

In exposing the region of a recent burn, extreme care should be taken to avoid rough handling of any destroyed and partially detached portions of skin. This precaution is especially necessary in burns or scalds of the second degree. It is advisable, particularly in cases of burning by caustic agents or through explosion of gunpowder, to remove by gentle syringing with warm water all foreign material that adheres to the injured surface. In the choice of local applications suitable to the different stages of burn, the surgeon has to attend to the following indications:—he should endeavour, in the first place, to cool the burnt surface and to relieve pain, and, after reaction has been established, to moderate local hyperæmia and prevent inflammation by excluding from the seat of injury such external influences as might set up irritation. When eschars have been formed, it becomes necessary, by attention to cleanliness, by the use of antiseptic agents, and by rest of the burnt part, to ward off attacks of cellulitis, and to neutralise any conditions that might be likely to induce septic infection. After the separation of all disorganised tissues, it is requisite to promote speedy cicatrisation, and at the same time to prevent, as far as possible, any subsequent cicatricial deformity.

In the local treatment of burns of the first degree, the main indications are to relieve the smarting pain by applying cold, and to bring about speedy resolution. If the scorched region extend over more or less of the surface of a limb, it should be covered with cold compresses, or the whole extremity be retained for one hour or longer in a cold bath, layers of cotton wool being subsequently applied when the pain and irritation have passed off. In the treatment of a superficial burn of the face, or of a small extent of the surface of the trunk, the immediate application either of iced water, or of lead lotion, or of diluted eau de Cologne, will be found beneficial. In a case of a burn of the first degree, involving one-half or more of the surface of the body, the patient, if an adult and well-nourished, will be much relieved by prolonged immersion in a bath of slightly warmed water; but if very young and collapsed, would be better treated by the local application of some cooling and oily fluid, and, over this, of a thick layer of cotton-wool.

The principal object in dealing with a burn of the second degree is to exclude as far as possible the external air from the seat of injury. If there be any very large vesicles, a few minute punctures should be made in the wall of each at the most dependent parts, so as to allow slow discharge of the contained serous fluid. It is very necessary to avoid laceration of the elevated epidermis, and undue and early exposure of the cutis. The burnt surface should then be covered by some thick dressing, so as to be protected against irritating agents until the complete reproduction of the destroyed epidermis. Mr. Erichsen recommends, in the local treatment of this as of other degrees of burn, the use of the finest wheaten flour, which, when laid on thickly but uniformly and gradually, forms a soft and soothing application to the surface. In cases of extensive vesication, strips of lint or linen which have been dipped in some thick or oily fluid will be found a more convenient and cleanly dressing. Of these fluids the best probably are carron oil (linseed-oil and lime-water in equal parts), carbolic oil (one part of carbolic acid to ten parts of olive oil), a mixture of olive oil and yelk of egg in equal parts. Chalk or zinc ointment, or one of carbonate of lead, spread very thickly on strips of soft lint, will each be found a suitable application to this form of burn. Cotton wadding, absorbent cotton wool and cotton tissue, treated with some antiseptic agent, constitute valuable material for dressings in every degree of burn, and may be applied in thick layers either directly to the injured surface or over any of the above-mentioned lotions or ointments. If cotton wool be applied directly to a vesicated surface, it will be advisable to retain the dressing until the burn has healed or the injured skin has become dry, as the flakes of cotton adhere closely to the loose epidermis, and if removed carelessly and too soon, might tear this away and expose a raw and irritable surface. In burns of this degree seated on the face or one of the limbs, if there be but slight vesication, the application either of castor-oil and collodion (one part to two parts), or of a super-saturated solution of bicarbonate of soda, is to be recommended. In cases of very painful scorching of the whole face, it will be found useful to brush over the reddened surface with some olive-oil or a diluted mixture of glycerine and boracic acid, and then to apply a thick mask of cotton-wool or wadding. In vesicated burns of limited extent, seated on the trunk or one of the extremities, nitrate of silver has often been found very useful when applied either in strong solution (one scruple of the salt to one ounce of water), or as the solid stick.

In treating burns of the third degree, the surgeon should act with the aim of accelerating the separation and removal of the eschars, of controlling putrefaction, and subsequently of promoting the cicatrisation of the open wound. The usual treatment, in cases where a portion of the skin has been destroyed and converted into sloughs, consists in covering the burnt surface with some stimulating dressing, and in applying over this a thick layer of antiseptic wadding.

The following are some of the most useful of the many preparations which have been commended as local stimulants: carron oil, turpentine liniment, carbolic oil, resin-ointment, Kentish's liniment of ceratum resinæ softened with spirit of turpentine, and the compound elemi ointment of the St. George's Hospital Pharmacopœia. The dressing should not be changed except when it is found necessary for the sake of cleanliness. At every exposure of the seat of burn, the sloughing surface should be irrigated and cleansed for some minutes with a tepid solution of carbolic acid (one part to thirty), or a weak iodine lotion, or a solution of chloride of zinc (ten grains to the ounce of water). After removal of the disorganised tissues, the exposed granulating surface is to be treated like any other form of healthy wound or ulcer.

Hebra, who objected to the use of ointments in the treatment of burns of the third degree, advocated the practice of continuous irrigation in cases in which the situation of the burn permitted its employment. He also advocated, as a mode of treating very severe burns, prolonged immersion in a bath of water maintained for many days, and, if necessary, even for months, at a temperature of from 90° to 100° F. This treatment seems to have been hitherto tried but in few cases, and not with any superior results. In order to carry out such a plan, the surgeon would require a special and very complicated apparatus, needing constant attention, and, if used for a very young patient, obviously not free from danger.

In the management of a large granulating surface formed in the more severe burns of the third degree, the surgeon's efforts should be mainly directed to overcoming the effects of cicatricial retraction, and to favouring, as far as can be done, the formation of a thin, smooth, and lax scar. After a deep burn of the face, of the front of the neck, or along the flexure surface of a large joint, more or less deformity must result; but the extent of such deformity, and the nature of the cicatrix may be much influenced for good by careful attention to both local and general treatment during the process of healing. By supporting the strength of the patient and warding off local inflammatory attacks, the granulating surface may be maintained in a healthy condition, so that it will heal steadily and with the formation of a thin yet sound scar.

If the burn involve the flexure of a large joint, as the front of the elbow or the surface of the popliteal region, any muscular contraction which tends to keep up flexion should be steadily resisted, and the affected limb be kept straight on a splint. In the treatment of a granulating wound in front of the neck and of the upper part of the chest, constant endeavour should be made to prevent depression of the chin. In burns about the mouth, external auditory meatus, or any other natural orifice, tents, or solid plugs or tubes with solid walls, should be inserted, with a view of preventing contraction. Much difficulty will be experienced, in deep burns of the hand, in preventing adhesion of two or more fingers. The best means of preventing deformity by reducing hypertrophy and controlling the retractile action of a large scar, are extension of the distorted parts and compression by elastic bandaging. Extension can be readily applied to the lower limb by using strapping and weights, whilst in the upper limb, and probably in some cases of depression of the lower jaw, some good in this respect may be done by ingenious applications of elastic accumulators. Compression may be best effected by firm strapping and the application of a Martin's bandage. In order that any real benefit may be derived from these plans of treatment, they must be carried out with much care and perseverance, and be continued long after the granulating surface has healed.

The eschars formed by very deep burns require similar local treatment to that recommended for other burns of the third degree. An injury of this severity, however, is usually fatal when seated on the trunk, and demands amputation when a portion of a limb is involved.

Primary amputation, the general condition of the patient not forbidding, is indicated when an extremity has been destroyed by a very severe burn. The operation should be performed without delay in any uncomplicated case of hopeless disorganisation of a foot or hand. Amputation has been performed with success even in cases where a portion of the trunk also was severely burnt, and instances have been recorded by Larrey of successful double amputations for burn: one of a thigh and an arm on the same patient, another of a leg and fore-arm, and one even of both thighs. If the extremity be wholly destroyed, the surgeon need not hesitate to take flaps from skin already involved in burns of the second or third degree. The following are the conditions in which it may be found advisable to perform secondary amputation:—Profuse and exhausting discharge from a large granulating surface on a limb, formed on the separation of a deep eschar in a severe burn of the third degree; when much of the integument of a limb has been destroyed, and the retraction of the resulting cicatrix renders the member quite useless, and also interferes with the movements of adjacent sound parts; when a large open surface cannot be healed, or when a large cicatrix has a constant tendency to ulcerate on movement of the affected limb; when a large joint has been opened during the detachment of a deep eschar, and is undergoing disorganisation; in cases of extensive exposure and necrosis of a long bone resulting from burn.

W. Johnson Smith.

BURSÆ, Affections of.—Bursæ may be divided into *subcutaneous* and *deep*. The deep bursæ intervene usually between tendons, muscles, and bones, but sometimes between muscles or tendons. The subcutaneous lie between the skin and exposed bony prominences. Most of the muscular bursæ are hereditary and fairly constant; but the majority of the subcutaneous are developed after birth.

Situations of Bursæ (*Head and Neck*). A large one (sublingual) exists between the genioglossi, back of the symphysis, and the mucous membrane on each side of the frænum, passing back behind the sublingual gland and Wharton's duct to the level of the first or second molar, and constricted in the mid-line by the frænum. *See* Ranula. Occasionally bursæ are seen on the symphysis and angles of jaw: between the back of the hyoid bone and thyro-hyoid muscle, and the thyro-hyoid membrane (thyro-hyoid): rarely on the pomum adami (ante-thyroid).

Upper Limb.—On the subcutaneous surface of the olecranon always; occasionally on the acromion, epicondyles, styloid processes, knuckles and backs of inter-phalangeal joints, bursæ are found. A large, generally loculated sac (sub-deltoid, sub-acromial) always exists between the deltoid and acromion and the head of the humerus. Beneath the tendon of the subscapularis, and along the tendon of the biceps, are protrusions of the synovial sac of the shoulder; fluid may run along the latter from the shoulder, and point beneath the great pectoral tendon. Bursæ are also found between the latissimus and teres major tendons, and between the latter and the bone: between the biceps tendon and the tubercle of the radius: between the triceps and the olecranon above its insertion: and around the tendon of the flexor carpi radialis where it grooves the trapezium.

Around the tendons of the superficial and deep flexors beneath the anterior annular ligament, extending from the level of the wrist-joint to rather below the bases of the metacarpals, is a large bursa divided into two parts—which may communicate—by a mesial septum; the inner surrounds the tendons of the fourth and fifth fingers, the outer those of the second and third fingers and the long thumb-flexor, and communicates with the special sheath of the latter round the flexor tendons in each digit, any one of which *may* join the bursa in front of the wrist. Six sheaths lie beneath the posterior annular ligament, beneath each of which there is a small bursa. Hernial protrusions of the intercarpal synovial membrane on the dorsal aspect are not uncommon.

Lower Limb.—The bursa patellæ consists of two or three distinct or intercommunicating superposed chambers, one at least being subfascial: and there is often another lower down in front of the ligament and tubercle of the tibia. Beneath the gluteus maximus, over the tuber ischii and origin of hamstrings, is a large bursa: another, large and loculated, is over the great trochanter and origin of the vastus externus; small ones exist beneath the tendons of the two smaller glutei, and still smaller in relation with the tendons of the pyriformis and obturator internus. Between the ilio-psoas and hip-joint is a large bursa, which may communicate with the joint: a small one beneath the crureus above the knee, with which it occasionally communicates.

Behind the knee on the inner side, beneath the inner head of the gastrocnemius, and also intervening between this muscle and the semi-membranosus, is an extensive bursa often communicating with the knee-joint. Lower down, between the insertion of the semi-membranosus and the tibia, is a small sac, and on the outer side, between the biceps and external lateral ligament, another, small and inconstant. In front of the upper end of the tibia, beneath the insertion of the ligamentum patellæ is a bursa: and another beneath and between the insertions of the sartorius, gracilis, and semi-tendinosus. Beneath the insertion of the tendo Achillis is a small bursa, and synovial membranes line the flexor sheaths in the toes, the peronei behind the ankle, the three compartments in the anterior annular ligament, and the sheaths in the internal annular ligament.

Injuries.—*Wounds* are recognised by their anatomical position, perhaps the escape of synovia, and the detection of an opened bursa by the eye or probe. Incised and punctured wounds, as a rule, heal easily, but may cause bursitis of all degrees of acuteness; whilst contused wounds, when septic, are often followed by suppuration of the bursa, and cellulitis leading from it. *Contusions*, without breach of surface, are not uncommonly followed by similar results, especially about the elbow; but simple hæmorrhage into the sac is common.

Treatment.—In the case of a wound, render the part aseptic, provide drainage if the wound is large enough to require it; apply some antiseptic dressing, and immobolise the part if practicable. Inflammatory complications must be treated as hereafter advised.

Diseases of Bursæ.—These are all inflammatory—acute or chronic.

Acute Inflammation may be serous or purulent.

Causes.—Wounds, contusions, extension of inflammation from surrounding parts; rarely, the extension of a slough of a boil into a superficial sac, and also, rarely, pyæmia. Often none is discoverable. Acute not uncommonly supervenes upon chronic inflammation. The common seats of acute inflammation are—the bursa patellæ (subcutaneous or subfascial, or both), and those over the olecranon, ligamentum patellæ, and tubercle of the tibia; much less commonly, the bursa beneath the insertion of the ligamentum patellæ.

Symptoms.—Redness, heat, swelling with more or less distinct fluctuation, and pain, localised to the situation of a bursa, or, attaining their maximum there, accompanied by more or less fever. In cases of acute suppuration these symptoms are well-marked, redness and œdema may extend some distance around, and the temperature is 101°-3° or even 104° F. If pus in a bursa is not evacuated, it may burst through the thick skin over it; but much more often subcutaneous or subfascial rupture and diffuse cellulitis result, perhaps running on even to sloughing of the subcutaneous tissue. Or the pus may burst into a joint, and, wherever there is danger of this, early relief is specially necessary, as in the case of the bursa beneath the ligamentum patellæ. Lastly, inflammation may spread from a bursa to the bone in which it lies, so that when the abscess is opened carious bone is found at the bottom; or a chronic septic discharge across a bone from a bursa may lead to the same result. This is sometimes found in suppuration of the bursa between the gluteus maximus and the great trochanter,—an affection which may present many of the symptoms of hip-joint disease. *See* Hip-disease. Lymphangitis and lymphadenitis are not uncommon complications.

Treatment.—In the earliest stage, rest upon a splint, and ice. Later on, but still before suppuration has occurred, rest, belladonna and glycerine freely applied, and fomentations changed every two hours. So soon as it is certain that pus is present, it should be let out by incision, a drain inserted, and an antiseptic dressing applied, preferably a large wool one, bandaged with moderate firmness.

If the pus has burst through the skin, and cellulitis is present, the best treatment is to render the drainage free, give rest, and apply fomentations of boracic lint.

If the sac has burst beneath the fascia, and suppuration is extending up and down the limb, free, and possibly numerous, incisions will be required to evacuate the pus, tubes must be inserted, and an antiseptic dressing applied. Frequent boracic fomentations act well. The sinuses are likely to be long in healing.

With regard to the bursa patellæ, an incision into its outer side gives better drainage than a central one, and the scar is less exposed to pressure afterwards.

Chronic Inflammation.—Several results are met with. Distension with serous fluid, the wall becoming rather thick and opaque (hygroma or simple dropsy). The fluid is sometimes deeply blood-stained, or may be thick and viscid, and bridle-like bands often project into the interior. Sometimes the wall continues to thicken, the fluid disappearing as it does so; in other cases fluid is never present in quantity, the swelling being due chiefly to thickening of the wall, which may not be uniform. The central cavity may be very small, but is rarely, if ever, obliterated. The thickening is produced either by fibrous tissue of inflammatory origin, or by fibrin, almost laminated and undergoing organisation towards the wall, deposited from blood or coagulable fluid effused into the cavity. Rarely, in old cases, the wall calcifies. Sometimes the interior presents a few or many warty, pedunculated growths; it is thought that these may become detached, and form one variety of loose body found in bursæ. Usually, however, these do not consist of connective tissue, but simply of fibrin, and they have very much the shape and appearance of melon-seeds. They may be dark brown from presence of blood colouring matter, and it is thought that they originate from fibrin derived from blood. It is not known to what they owe their peculiar form. In bursæ actually connected with joints, cartilaginous bodies have been found.

Causes.—Chronic irritation, generally of the nature of friction or contusion.

Seats.—The most common are—the bursa patellæ and others lower down, over the ligament (housemaid's knee); the bursa over the olecranon (student's or miner's bursa); that over the tuber ischii (weaver's bottom); those over the external malleoli (tailor's bursa). These frequently show all the pathological changes described above; whilst deeper bursæ in the neighbourhood of joints are generally affected by simple dropsy only. The bursa between the semi-membranosus and inner head of the gastrocnemius is that most commonly affected.

Symptoms.—A more or less rounded swelling in the situation of a normal bursa, or occurring upon a spot exposed to unusual pressure, varying from the size of a fœtal head downwards—the larger sizes being rare nowadays; enlarging, perhaps rapidly at first, but without acute symptoms, then increasing slowly, if at all; sometimes very lax, again tense, elastic and fluctuating (in simple dropsy); the skin either thickened or, less commonly, stretched so as to be even translucent. With thickening of the wall the swelling becomes firmer, and fluctuation less and less distinct, reaching stony hardness with calcification. Irregular thickening and warty growths are felt if the sac is not so tense as to prevent its walls being pressed into contact. Loose bodies may yield soft crepitus on palpation, and in lax sacs they may be felt and chased from spot to spot; but in tense bursæ they are often first discovered upon opening or aspirating.

Treatment.—When only a few weeks old, counter-irritation with Lin. iodi or blisters, *applied freely*, may cause absorption of the fluid, but it often fails. Aspiration, repeated in three or four days, if necessary, together with fixation upon a splint to which the limb is strapped or bandaged, so as to make firm pressure on the bursa, is more successful. In similar cases, the bursa may be tapped, and injected with a solution of iodine (Tr. iodi and water, equal parts—Billroth), the fluid being allowed to escape after two minutes, and absolute rest for some days being insisted upon. Lastly, strong pressure may be made upon the bursa with a flannel bandage, a splint being placed on the other side of the limb (Volkmann). Reabsorption occurs in two to eight days, according to the size and chronicity of the swelling. In the case of the bursa patellæ sufficient pressure is used to cause œdema of the foot.

When loose bodies are present, they must be completely removed. The best plan is a sufficiently free incision to secure this, and then drainage and an antiseptic dressing. If either local or general thickening of the walls exist in any marked degree, the only treatment certain to cure is excision of the whole bursa. The incision should be placed to one side of the point of chief pressure. Should excision be impossible, removal of a portion of the wall and prolonged drainage may be tried.

The most difficult cases to treat are those of deep bursæ, possibly communicating with a joint, such as are commonly met with in the popliteal space. If the bursa can be emptied into the joint, communication is clear; but, even when this could not be done, inflammation, excited with a view to curing the bursa, has spread to the joint. After the failure of counter-irritation and pressure, which is difficult to apply, it is right to consider whether it is necessary to do more. If it is, cure will be effected almost certainly, and with the least risk to the patient, by antiseptic drainage. This has failed, however, and the sac has been dissected out.

Sometimes a very chronic sinus remains after the bursting or laying open of a bursa. This is best treated by a free incision and the application of the sharp-spoon.

Stanley Boyd.

BUTCHER'S SAW, consists of a narrow steel blade with fine teeth, set in a framework of metal, in which it can be turned so as to work in any direction, and from which it may be readily detached. This saw has been found very useful in excisions and in the removal of small exostoses and of thin sections of bone. The blade, Mr. Butcher states, cannot be locked, cuts more evenly and rapidly than that of the ordinary form of saw, and does not cause splintering. It readily cuts in a curve, and its shallowness and mobility permit of its being applied to the deep surface of a bone, so that it may in sawing be directed towards the surface of the wound, the tibia in excision of the knee being thus divided from behind forwards, and the radius and ulna, in excision of the elbow, from before backwards.

BUTTON-SUTURES.—This term was first applied to an apparatus used by Bozeman in operations for closing urinary vaginal fistulæ. The pared edges of the fistula having been brought together by silver wire, an oval and perforated plate of lead is passed along the free portions of the wires, and is retained over the wound by means of split shots. Another and double form of button-suture is used by Sir Joseph Lister in closing deep and wide wounds after operations on the trunk or limbs. Each suture is composed of two thin perforated discs of lead and some stout silver wire. The lead plates are applied each at some little distance from the edge of the wound, and are connected and approximated by the silver wire being drawn tight enough to allow the edges of the wound to come easily together. The edges of the wound may then be brought together by the ordinary interrupted suture without stretching or irritation. *See* Antiseptic Surgery.

C

CACHEXIA. *See* Malignant Disease.

CADAVERIC WARTS.—A chronic, inflammatory thickening of the integuments, due to the local absorption of decomposing animal matter.

This affection is not infrequent on the hands of those who have to make many post-mortem examinations. Sometimes it begins with a small crack or pustule, but more often, without any evident breach of the surface, the skin at some point of the knuckles is observed to become thick and rough. The thickening spreads, and the skin assumes a livid, purplish colour, and, after a time, there is a deposition of pigment, which gives the elevation a brownish appearance. The epidermis may become cracked and scaly, and a condition is then produced which resembles ichthyosis. In many cases the thickening develops into a low warty growth, half an inch or more in diameter, and elevated nearly an eighth of an inch above the adjacent skin. In other cases the papillary structures do not appear to be so much affected, and the disease has more of the aspect of a chronic eczema. Several fingers are often simultaneously affected in both hands, usually on the knuckles of the metacarpo-phalangeal, but sometimes upon those of the first phalangeal joints. According to Dr. Wilks, who first described it, those who are subject to this affection may continue their avocation with impunity as regards putrid absorption or inflammation of the lymphatics, for, as far as he has seen, neither these nor any constitutional symptoms result. The low warty growths may bear some resemblance to an early stage of epithelioma, but their multiple occurrence, the absence of glandular implication, and the employment of the patient, will generally suffice for their recognition.

The disease may persist for many years after the irritation which has caused it has ceased. It is advisable to keep the hands from contact with decomposing animal fluids, by desisting from pathological work, or by adopting the protection of india-rubber gloves. In the earlier stage of the disease it will be sufficient to apply the strong tincture of iodine. If this fails, the surface should be cauterised with nitric acid, or the liquor hydrargyri nitratis. When the swellings have a distinctly warty character, it may be necessary to resort to excision.

N. Davies-Colley.

CÆSAREAN SECTION is the operation for the removal of the child and placenta from the uterus at term, by abdominal and uterine section. It is performed when delivery is impossible by the natural method, even if the child be sacrificed and embryulcio performed.

Some difference of opinion exists as to the indications for the operation, and especially between British and Continental authorities, but a discussion of this subject will be found in any of the best obstetrical works, and is beyond our limits here. The necessity for the operation may arise either from pelvic deformity, (rachitis and mollities ossium are the diseases which most often cause such pelvic deformity), or from the presence of a tumour fixed in the pelvis, most often a fibro-myoma, or from cancer of uterus, cervix, or rectum, or exostosis of the sacrum. The late Sir James Simpson taught that when the brim of the pelvis is below $1\frac{1}{2}$ or $1\frac{3}{4}$ inches in the conjugate by three inches in the transverse diameter, or when the cavity or outlet is much contracted, Cæsarean section should be performed. The operation should be performed before the mother's strength is exhausted. It is well to wait till labour be sufficiently advanced for the os to be well dilated, on account of the drainage of the uterus. It is an alternative to craniotomy, cranioclasm, and cephalotripsy. In some cases it may be performed even though the mother be dead, in order to save the life of the child.

Operation.—The bladder having been emptied by the catheter, the vagina and vulva carefully cleansed with an antiseptic solution, and the rectum cleared by enema, the patient should be laid on her back on a convenient table, and with exactly the same preparations as for ovariotomy. *See* Ovariotomy. An incision should be made in the linea alba about five inches long, and, when the peritoneum is reached, great care should be exercised in dividing it, for fear of wounding the highly vascular pregnant uterus. When all bleeding from the parietal incision has ceased, and the uterus has been fully exposed, the placental site should if possible be determined in order to avoid it in incising the uterus. A longitudinal incision from four to five inches long should then be made in the uterine wall (a small opening with the knife rapidly extended with scissors); the hand introduced and the child extracted, head first, as quickly as possible, and handed to an assistant, who ties the umbilical cord. The placenta should also be extracted, being peeled from the uterine wall if necessary; then the index finger should be pushed through the cervical canal into the vagina, to insure this canal being left patent, and it may be well to pass through it a soft rubber drainage-tube, with large side holes, just long enough to extend from above the internal os into the vagina; the hand should then be quickly withdrawn, and the uterus grasped till it contracts firmly.

The very greatest care should be taken, during the incision of the uterus and the extraction of the child and placenta, to prevent escape of blood or liquor amnii into the peritoneal cavity, and this may be most safely done by placing large, soft, flat, carbolised sponges all round between the parietal peritoneum and the uterus, and causing an assistant to press the parietes firmly upon these sponges during the extraction. The uterus should be grasped to cause it to contract, and when it has contracted firmly, a row of fine carbolised silk sutures should be inserted through the whole thickness of its wall, by means of a fine curved needle. Each suture should include about a quarter of an inch of the peritoneal edge, and slant through the uterine wall, merely catching the mucous membrane and not going right through it into the cavity. These interrupted sutures should be about a quarter of an inch apart in the contracted wall, and after they have been securely tied and cut short, a fine continuous carbolised silk suture should be run along over them through the peritoneal coat only, the needle being made to transfix the peritoneum between these interrupted sutures.

The peritoneum should then be carefully sponged out, and the abdominal incision closed as in ovariotomy, a small gauze dressing being applied over the wound, and outside this a firm folded towel as a pad, and over this the usual adhesive straps; then outside the straps a large folded mass of cotton wool, over which a lined flannel bandage is pinned; this keeps up a firm elastic pressure on the uterus. The vagina should be syringed with warm 1 to 60 carbolic lotion, and lightly packed with iodoform gauze, which should be changed every twelve hours under the spray for the first few days. A subcutaneous injection of ergotin, and the early application of the child to the breast (if the mother be not too much exhausted), are advisable, as likely to keep the uterus firmly contracted.

In the event of the child being already dead and putrid, still greater care will be necessary to avoid fouling the wound, which should be completely covered all round the projecting uterus with napkins wrung out of warm 1 to 40 carbolic lotion. The uterine cavity should be well sponged out also with a strong solution of iodine, and a Keith's glass tube, with rubber sheet and carbolised sponges, should be used for draining the pelvis. This latter precaution may be advisable, not only in cases in which the child is putrid, but in any case in which escape of uterine contents into the peritoneal cavity has occurred during the operation.

The treatment of the patient after operation should be similar to that advised after ovariotomy. When syringing out the vagina and packing it after the operation, the rubber tube should be pierced by a safety pin placed across the os so as to prevent its being drawn into the cavity, and the tube may be removed altogether in about forty-eight hours when the peritoneal wound in the uterus is sealed.

J. KNOWSLEY THORNTON.

CALCIFICATION is an indication of diminished nutritive activity. This is true both as regards health and disease. Physiologically the deposition of lime-salts is the last of the series of changes concerned in the formation of bone where it is purposive, inasmuch as it gives the required durability, but at the same time it marks the loss of formative power of the osseous corpuscles. Pathologically it may occur as a primary change in previously healthy tissues, but more frequently it is consecutive to some other form of failure in nutrition—inflammatory or degenerative.

It is very widely distributed in the *vascular system*; thus it is found in the *heart*, affecting the valves and the walls of the coronary arteries; and large stony plates are occasionally met with in the pericardium.

The *arteries* are peculiarly prone to petrifaction. The muscular fibre-cells of the middle coat of the small and medium-sized vessels are often converted into calcareous rings, and the neoplasia of chronic endarteritis of the large arteries is very liable to infiltration with lime-salts.

The *veins* are subject to the change both as regards their walls and contents. In them, as in the smaller arteries, the tendency is for the middle coat to be first invaded. The rigidity of the vessels thus occasioned is a secondary cause of thrombosis. *Phleboliths* are mostly found where there has been passive venous congestion —a condition favourable both to chronic plastic phlebitis and coagulation of blood. There is some doubt how far these calculi are petrified clots, or inflammatory buddings of the intima that have undergone calcification. They are most common in the prostatic venous plexus.

Disorderly calcification is one of the chief anatomical features of *rickets*, in which disease the epiphysial cartilage-cells are imprisoned, and their natural segmentation checked by the calcareous deposit in the secondary capsules.

Taken as a whole, calcification is most common in tissues that have succumbed to *chronic inflammation*. Examples of this in the vascular system have already been cited. The lesion is not rare in the membranes of the brain and cord; thus one meets with broad plates in the cranial dura mater, especially in old people. The author has observed patches of calcification as a sequel of traumatic, cerebral, and spinal meningitis. A like condition may be acquired by articular and synovial sheaths which have been chronically inflamed. But whilst calcification occurs in these cases of fibroid induration, it is much more likely to happen in connection with caseation of inflammatory products; thus it is met with in 'obsolescent tubercle' of the lungs and lymphatic glands. The inspissated pus of cold abscesses may contain such an excess of lime-salts as to simulate mortar of various degrees of consistence and grittiness. It is an interesting fact that passive congestion conduces alike to absorption of earthy salts from normal bone, and to their re-deposition in the contents of consecutive abscesses, as exemplified by the history of scrofulous caries.

Calcification sometimes affects the pyramidal blocks of degenerating tissue, the result of aseptic arterial embolism. There is scarcely an instance of fatty metamorphosis where calcareous infiltration may not be found in greater or less extent. It is a possible sequel to such widely different processes as 'ossification' of the choroid coat of the eyeball, extra-uterine gestation, and retrogression of the thymus gland. The interstitial tissue of the internal organs—the lungs and kidneys, e.g.—may be the seat of diffuse calcareous deposit secondary to absorption of the bone-salts from the osseous system generally.

Of the *new-formations*, those characterised by slowness of growth and other signs of benignancy are, by preference, selected by the process of calcification. The enchondromata are peculiarly prone to petrifaction with or without true ossification. In them, as in other tumours, the cells are invaded subsequently to the matrix. The *fibromata* may undergo interstitial or, much more rarely, capsular calcification. *Uterine fibroids* are now and again observed to be converted into stony masses.

The *psammomata* which, on anatomical grounds, are by Cornil and Ranvier classed with the sarcomata, are typical of calcified neoplasiæ. They are small, concentrically laminated, globular concretions found in the choroid plexuses and other parts of the pia mater. The deposit affects chiefly the walls of the capillaries.

Cysts are sometimes converted into a kind of shell or carapace. This is notably the case in hydatid and atheromatous or sebaceous tumours. Calcification may occur as a secondary change in *hypertrophy of the thyroid gland*, where it is usually seen in the form of cretaceous nodules.

Fragments of a calcified growth appear opaque when viewed by transmitted light. The constituent cells may be completely hidden, but their outline becomes apparent on the addition of a dilute mineral acid. The chinks or clefts present in these tumours must not be mistaken for the lacunæ of true bone. They do not contain corpuscular elements. Calcification is the essential process in the formation of salivary and many urinary calculi. In the majority of cases of calcareous infiltration the salts consist of calcic carbonate and tribasic phosphate.

AUGUSTUS J. PEPPER.

CALCULUS, Prostatic. *See* PROSTATE, Diseases of the.

CALCULUS, Renal. *See* NEPHROLITHIASIS.

CALCULUS, Urethral. *See* STONE IN THE URETHRA.

CALCULUS, Urinary.—Urinary concretions assume different forms, and exhibit great varieties both in their general appearance and chemical constitution.

The most common forms are simple calculi of uric acid or of oxalate of lime, and the compound calculi of phosphate of lime, with ammonio-magnesian phosphate, or of either of the above elements with mixed phosphates. Less frequently observed calculi are those of urate of ammonia, of triple phosphate, and of cystine. The most rare forms of urinary calculi are those composed of xanthic oxide, pure phosphate of lime, and of carbonate of lime. In this country uric acid calculi make up about 25 per cent. of the whole number, the fusible or mixed phosphatic calculi about 10 per cent., and the oxalate of lime calculi about 15 per cent. The relative proportions of the forms of calculi would seem, according to the investigations of Indian collections by Dr. H. V. Carter, to vary in different countries.

The *uric acid calculus* has a smooth or slightly nodulated surface, is of a reddish-brown, yellow or fawn colour, is more or less ovoid in shape, and hard and compact. It is met with in greatly varying sizes, some stones weighing but a few grains, and others from six to eight ounces. The central portions are for the most part darker than the peripheral. On the application of heat it is found to be combustible, leaving very little residue. It is soluble in nitric acid with effervescence; and, on evaporation, with the addition of a few drops of ammonia, presents a blood-red hue. It is also soluble in a dilute solution of potash, and of carbonate of potash, but is insoluble in water, alcohol, and dilute hydrochloric acid.

The *oxalate of lime* or *mulberry calculus* is mostly darkish brown in colour, varying from this to a dark green, yellowish-brown, bright yellow or white. It usually presents sharp angular projections, or has a very rough and tuberculated surface. It is spherical in shape, is very hard and compact, and, on section, exhibits a laminated and finely granular texture. The oxalate of lime calculus, in its ordinary form, is usually single, but there is a variety of this concretion called 'the hemp-seed calculus,' consisting of very small, pale, and smooth bodies, which are sometimes found in large numbers in the kidney.

The white variety of mulberry calculus is crystalline, and consists of nearly pure oxalate of lime. This form is very rare. Oxalate of lime calculi are found to be soluble in hydrochloric acid, but insoluble in acetic acid and in water. They burn with a white glow under the blow-pipe, and the moistened residue gives an alkaline reaction.

The *ammonio-magnesian* or *triple phosphate calculus* is rare, and very few specimens are to be found, even in the largest collections. The calculus is usually large, and has been found mostly in men of advanced life. It is more or less oval in shape, white in colour, with a beautifully crystalline surface; on section it is found to be indistinctly lamellated. In some specimens the texture is compact, in others soft and friable.

The *ammonio-magnesian phosphate of lime*, or *fusible calculus* is of frequent occurrence, and often attains a considerable size; the largest specimens in collections of calculi being mostly of this variety. This calculus is of a white colour, usually globular or ovoid, but sometimes very irregular in shape, light as compared with other forms of stone, and brittle or quite soft. It is this material that forms the well-known incrustation on foreign bodies introduced into the bladder.

The *cystic oxide* or *cystine calculus* is small, and rounded or oval in shape, with a smooth or slightly tuberculated surface, and has a yellowish-white or pale green colour. It has a glistening appearance, and on section gives off a peculiar garlic-like odour. It is combustible and burns with a bluish flame and characteristic odour, and is soluble in nitric and other mineral acids. It contains above 25 per cent. of sulphur. This variety of calculus is formed in the kidney, and has a tendency to recur in the same patient. There seems to be some hereditary predisposition to its formation, as, according to Poland, out of twenty-two collected cases, ten occurred in four families.

The *xanthic oxide* is probably the rarest form of urinary calculus, four instances only having been recorded. The smallest of these weighed eight grains, and the largest 339 grains. It presents a smooth surface, and a cinnamon-brown or reddish-yellow colour, and is made up of concentric wavy laminæ. It leaves very little, if any, residue on combustion, and is soluble in the mineral acids.

The *phosphate of lime calculus* is very rare in the pure form. It is hard and compactly laminated, and has a smooth, porcellanous surface. When submitted to the blow-pipe, it whitens but does not fuse, and is soluble in hydrochloric acid without effervescence. Phosphate of lime, though very seldom met with as a true renal or vesical calculus, forms the bulk of the so-called 'bone-earth' calculi, or the soft amorphous masses of deposit so frequently found in cases of diseased bladder with decomposed urine.

Carbonate of lime enters into the composition of some few forms of prostatic concretion, and is occasionally met with in animals, but very rarely, if ever, forms a true urinary calculus in the human subject.

A mixed or *alternating calculus* is one made up of different layers of any of the foregoing varieties. This mixed composition is the result of changes in the condition of the urine at different stages of the growth of the stone. Hence a change of residence, even from one part to another of the same country, or a material alteration in the habits of life of the patient, may be promoting causes. The most frequent combinations are: a nucleus of uric acid with a body of pure uric acid or of urates and a crust of phosphates; a nucleus and body of oxalate of lime, and a crust of irregular thickness, composed partly of phosphates, partly of uric acid; a nucleus of uric acid or of urate of ammonia, surrounded by alternating layers of uric acid and mixed phosphates.

The so-called fibrinous, sanguineous, and uro-stealith calculi being simply concretions of organic matter, and not crystalline formations, need not be considered here.

The development and growth of each of the ordinary forms of urinary calculus are associated with a somewhat characteristic condition of the urine. In the uric acid diathesis this secretion is scanty, highly-coloured, and deposits on cooling distinct coloured crystals of uric acid, forming the well-known 'gravel' or 'cayenne-pepper' deposit. A reddish-yellow 'brick-dust' sediment—probably urate of ammonia—which disappears on the application of heat, or on pouring water into the vessel containing the urine, is common in health and must not be confounded with the uric acid deposit. In cases of oxalate of lime calculus, the urine is pale and abundant without sediment, and generally contains traces of blood, and crystals of oxalate of lime may sometimes be detected on microscopic examination. In association with phosphatic calculi, the urine is pale and copious. It soon decomposes, and then becomes very offensive. It is very often alkaline, and contains much mucous deposit. *See* STONE IN THE MALE BLADDER. T. W. CROSSE.

CALCULUS, Vesical. *See* STONE IN THE MALE BLADDER; STONE IN THE FEMALE BLADDER.

CALLISEN'S OPERATION, *See* COLOTOMY.

CALLUS. *See* FRACTURES.

CALOMEL VAPOUR-BATH.—In the opinion of Mr. Henry Lee, who has long advocated calomel-fumigation in the treatment of constitutional syphilis, the most convenient apparatus to use in giving a calomel vapour-bath is one that sublimes the calomel and boils the water at the same time. Mr. Lee's apparatus consists of a metal receptacle with perforated walls, in which the lamp is placed, and immediately over the wick is a small circular plate, on which from ten to twenty grains of calomel are placed, and around this plate is a depression, into which is poured boiling water. The lamp having been lighted and the apparatus placed on the ground, the patient, covered from head to foot by a thick cloak of some impermeable material, sits over it on a cane-bottomed chair, and remains there for about a quarter of an hour, surrounded by a mixture of aqueous vapour and sublimed calomel. The surface of the body, during the bath, becomes covered by a black deposit of calomel, which should be disturbed as little as possible for some hours.

CANALISATION OF CLOT.—The process by which restitution of the lumen of a vessel is effected after occlusion by organisation of a thrombus.

This result is an outcome of the ordinary cicatricial changes occurring subsequently to the vascularisation of a thrombus. The channel may be a single one, as is occasionally seen after ligature in continuity of an artery, the vessel not being completely divided. The channel in this case is considerably smaller than the original one. In other cases the clot may become permeated by numerous channels, a condition sometimes noticed after thrombosis of the larger veins, such as the iliacs. In either case the permanent channel is due to the enlargement of one or more of the new blood-vessels formed during vascularisation of the clot. This enlargement is effected by the shrinking of the young connective tissue forming the organised thrombus, aided, in some degree perhaps, by the intravascular pressure. G. H. MAKINS.

CANALISATION OF THE PROSTATE (Perforation of Prostate. Forcible Catheterism).—This operation was formerly practised in prostatic retention of urine, when the catheter could not be passed. A No. 10 stout silver catheter with a conical point was passed down to the prostatic obstruction, kept steadily in the middle line, and the shaft forcibly depressed until the point penetrated the base of the middle lobe and entered the bladder. Sometimes the catheter was made with a terminal orifice, through which a sharp-pointed stylet could be protruded, to prepare a way for the catheter. When the bladder was reached, the catheter was retained for a day or two, and then immediately replaced by another, and so on, until the surgeon considered that the false passage had become a permanent canal. Owing to the introduction of soft catheters of all shapes, the operation belongs entirely to the past. Patients so treated were exposed to grave risks. It can only be justifiable now, when the case is urgent and the surgeon beyond reach of soft catheters, or instruments for suprapubic tapping or aspiration.

G. Buckston Browne.

CANCER is a term used differently by different authorities. By some it is employed as equivalent to carcinoma; by others as a generic term for any truly malignant growth. *See* Carcinoma; Sarcoma; Malignant Tumours.

CANCRUM ORIS. *Synon.*: Noma of the mouth, Gangrenous stomatitis.—A rare form of gangrene of the lips and cheeks in weakly children, often after an acute fever: it is painless, rapid, and intractable, and causes death by blood-poisoning, or bronchitis, or pneumonia.

Although there are many intermediate forms of disease between cancrum oris and ulcerative stomatitis, yet a marked case of cancrum oris cannot be mistaken. The cheek is hard, hot, glossy, swollen, œdematous, invaded by a spreading patch of gangrene which is black edged with red; the whole thickness of the cheek is killed and putrid; the bones are bare, grey, and dead; the teeth come out. The disease may begin in the substance of the cheek, without visible disease of the mucous membrane; but usually the mucous membrane is affected early or primarily. The disease is at first insidious and often neglected, attacking as it does those children who are always weakly and ill-fed. Even after it has gone on to perforation, there is strange freedom from pain, strange indifference to the hole in the cheek, save for the difficulty in taking food; the child will even finger it inquisitively, and cover it with the hand while swallowing. Later, the child becomes exhausted and stupefied, or delirious and feebly restless, and dies either suddenly, as if from sheer exhaustion, or poisoned by the products of putrefaction, or from bronchitis or pneumonia due to inhalation of these products.

In one case at least, both cheeks have been attacked. It is almost confined to children of a few years old: in two cases of adults it is noted that there seemed to be more suffering than children feel.

Cancrum oris is something more than stomatitis, but it often begins in stomatitis, and has much in common with it. All forms of stomatitis, except the special ulcerations of syphilis and tubercular disease, are due in part to ill-health and severe depression; the mucous membranes being as much a register of the general health as the skin. The same causes predispose the child to cancrum oris; it is a disease of children depressed by all the evils of the worst poverty; it follows measles, typhoid, scarlet fever, ague, or some such cause. Bad drainage, the frequent cause of sore-throat and ulcerative stomatitis, probably also is at work in cancrum oris. It may follow the abuse of mercury (West), or the prolonged suppuration of a bad burn.

As regards successful treatment it is almost hopeless: the recorded deaths are 13 out of 18 (Hinder), 8 out of 10 (West), 20 out of 21 (Rilliet and Barthez), all out of 36 (Taupin of Paris). With more cheerful statistics comes a doubt whether those cases that recovered were all cases of real cancrum oris.

These three points, then, mark it off from ulcerative stomatitis: 1. Its destruction of the whole thickness of the cheek. 2. Its almost certain fatality. 3. Its advance, quite unchecked by chlorate of potash. Still, between it and ulcerative stomatitis there are intermediate forms, and there is no evidence that the difference is more than one of degree.

Pathology.—There are two views: one, that it is only a local expression of the general low vitality of the child—a local death preceding death itself, like the loss of hair or nails after a fever, or the sloughing of the penis after typhus (Holmes); the other, that it is due to a special poison. As regards the first view, the difficulty is to see why the cheek should be thus singled out. In other forms of gangrene from malnutrition, as in diabetes, and after loss of blood and exhaustion, the gangrene is of the extremities. The cheek is so richly supplied with blood, so quick to heal, that it would hardly be the first part of the body to give way under a general depression, but rather the last.

As regards the other view, it may be that in cancrum oris some other agent is added to those already at work upon the health of the child. This fresh factor is not the lingering effects of a fever through which the child may have recently passed, for cases of cancrum oris occur without this. Nor is it only the evils of poverty; for in that case cancrum oris would be much more common. Rather it is probable that this added something is imported from without; that it is a fresh disease, a poison like the poison of syphilitic phagedæna and hospital gangrene, perhaps indeed the very same as these. These diseases are contagious; all they require is a proper soil and cultivation. And that cancrum oris has not yet been proved to be contagious, or to spread an epidemic of phagedæna, is due to its rarity, and to the prompt treatment given to it; and also, as Hutchinson suggests, to the fact that, as its process is very rapid and almost wholly one of gangrene, it destroys its own living pus-cells and nuclei, and thus limits its own power of spreading by contagion.

Thus, as phagedæna is a contagious disease, invading syphilitic sores—primary, secondary, and tertiary—commonly in young, fair, thin-skinned patients, whose secondaries are of an ulcerative type; attacking the patient, in many cases, more than once; laying hold on chancres of the glans more often than those of the foreskin, and on foul ones more often than clean ones; so cancrum oris also is phagedæna, invading the weakened or abraded or already ulcerated mucous membrane of the mouth in half-starved, fever-wasted children, or possibly first entering the circulation, and then finding in the cheek a suitable soil for development.

As yet, no organism has been isolated from cancrum oris, nor has the disease been inoculated. Dr. Sansom, examining the blood, urine, fæces, and discharge from a case on the third day, found in all of them small highly refractile bodies, like colourless crystals, about one-twentieth part of the size of a red corpuscle; their movement was spontaneous, rectilinear, influenced by chemical agents. They formed zooglœa-like masses, and became fewer with hæmorrhage and fall of temperature. The blood, injected into mice, produced septicæmia and death, with multiplication of the refractile bodies; the discharge, injected into a cat's abdominal cavity, produced fatal peritonitis, but no refractile bodies were found in the blood. (*Med.-Chir. Trans.* lvi.) In a second case of cancrum oris, Dr. Sansom did not find these refractile bodies. In the first case, he found the white cells irregular, diffluent, granular, and unduly numerous, the red cells unduly small. The nature and action of these refractile bodies remains uncertain; but the observation is of great value.

Lastly, it may be observed that Mr. Hutchinson's teaching as to cancrum oris is more in favour of this view than it was. In 1856 he says it differs from ulcerative stomatitis probably in degree only—that it is only an intense and rapid form of it; though he does not deny that possibly mere ulcerative stomatitis may be connected with a specific poison. In 1877 he classes together cancrum oris and noma as forms of sloughing phagedæna, and thus as allied to or identical with the contagious diseases called hospital gangrene and syphilitic phagedæna.

The *treatment* of cancrum oris is very discouraging. Every case of ulceration of the mouth of a child must be carefully watched. If it does not improve under large doses of chlorate of potash, with wine, tonics, good food and air, and local treatment, chloroform must be given, the cheek must be exposed, rubbed, and dried, and then carefully and slowly soaked with the strongest nitric acid. A saturated solution of bicarbonate of soda or potash should be at hand, to guard the action of the acid. The application may be necessary more than once.

If the child is not seen till the cheek is red, hard, and swollen, the acid must be applied at once, and poultices externally. If the black patch of gangrene has already appeared, it is useless to cauterise the inside of the cheek; it is best at once to punch out the rotten slough, to scrape and dry the hole all round as much as possible without making it bleed, removing as much dead tissue as will come away, and then to apply the acid freely. But in such a case, the sodden putrid tissues are apt to suck up the acid, and prevent its reaching the ever-advancing edge of the disease, and repeated applications only make bad worse. Since this is so, might it not be better, when once the whole thickness of the cheek has sloughed, to excise the whole slough with the knife? If the knife were carried clear round the disease, the first suspicious spot in the granulating wound would be immediately seen, and if only the angle of the lips were saved, the deformity might not after all be very bad. The use of the actual cautery, as Trousseau recommends it in advanced cases, 'by repeated application, including the whole thickness of the cheek, the gums, and the exposed bone,' is at least as severe. Both acid and cautery leave an eschar, which hides the spread of the disease and hinders their own further efficacy. It is possible that, in some cases, free excision might save life, where they would not. STEPHEN PAGET.

CAPELLINE BANDAGE. *See* BANDAGES.

CANQUOIN'S PASTE. *See* CAUSTICS.

CARBOLIC ACID. *See* ANTISEPTIC SURGERY.

CARBUNCLE (*Syn.*: Anthrax) is a specific local inflammation of the superficial connective tissue, affecting to some extent the skin, and characterised by numerous openings which lead to a subcutaneous slough.

Its *Causes* are similar to those which produce boils. It is, however, usually found in those who are past middle life. Men are more subject to the disease than women. It attacks those who are debilitated by too good or too poor living. Thus, the plethoric and gouty suffer from it as well as convalescents from zymotic disease, and women who have been weakened by prolonged lactation. There is often a history of antecedent dyspepsia. The diabetic are especially liable to it, and according to Billroth, it is also frequent among uræmic patients. It has been known to follow the eating of diseased meat. The locality of the affection is often determined, in those who are already predisposed to it, by some friction or pressure. Hence it is apt to occur on the nape of the neck or on the nates.

Symptoms and Course.—Beginning as a red, hard, and very tender swelling of the skin, it rapidly spreads by the margins until a circumscribed, somewhat flattened elevation is formed, varying from an inch to six inches or more in diameter, and elevated one quarter to half an inch above the surrounding integuments. The colour which is at first red, soon becomes dusky, and even livid. In less than a week vesicles form over the middle of the swelling. These burst and leave a number of small openings, from which a thin sanious discharge exudes. As the openings widen, a greyish-yellow slough becomes visible. In the course of a few days they coalesce, and form a ragged aperture from which pus freely escapes, accompanied by large masses of slough. Soon a granulating cavity is left with undermined edges. By secondary union, and by the growth of the granulations, this is converted into a healing ulcer, which rapidly contracts and skins over. A puckered and somewhat discoloured scar remains.

The disease is usually single. Sometimes it shows a tendency to creep at the margins while the sloughs are being discharged at the centre. The duration may vary from two or three weeks to several months. It is apt to assume a chronic form in weakly patients, or where the thick skin retards the formation of the apertures by which the slough is discharged.

There is often considerable constitutional disturbance preceding the outbreak, such as chilliness, or even rigors, feverishness, irritability, and dyspepsia. While the swelling is growing, the fever may be of the sthenic type, and the pain is of an intense, throbbing character. In the aged, and in those in whom the affection has lasted two or three weeks, great prostration, with a typhoid condition, may supervene, and there is danger that death may occur from exhaustion or pyæmia. When the scalp is affected head-symptoms may ensue, and the patient may sink from coma preceded by delirium.

Pathology.—A carbuncle may be looked upon as a collection of boils, and it differs from them chiefly in the large destruction of skin by which it is attended. It is probable that the disease attacks first the sebaceous glands of the hair-follicles. Its chief site is in the connective tissue around them and immediately beneath the skin. The slough is composed of connective tissue infiltrated with fibrinous exudation and leucocytes. It is full of oil-globules from the disintegration of these structures, and its evascular condition is shown by the dirty yellowish-grey surface exposed when free incisions are used. The muscles are rarely attacked. It may sometimes give rise to plugging of the veins, and in this way lead to pyæmia.

Diagnosis.—Carbuncle may be distinguished from a boil by its size, by the numerous openings, by the livid colour, and by the fact that it is rarely multiple. From other phlegmonous inflammations it may be known by its circumscribed character, its brawny hardness, and the sieve-like perforations of the central covering. The peculiar character of the eschar will usually suffice for the recognition of MALIGNANT PUSTULE.

The *Treatment* by *local* means may be classed under four heads—

(1) Two free incisions may be made at right angles to each other through the slough into the living structures beneath and beyond. This method relieves pain and facilitates the discharge of the slough, but it is attended with so much bleeding that it should only be used in the young and robust.

(2) The same advantages can generally be obtained by the use of potassa fusa, small pieces of which should be thrust

through the openings into the slough beneath. If the openings are slow to form, or not large enough, small incisions may be made before inserting the caustic. By this plan the gangrenous mass is speedily and with little pain converted into a blackish gelatinous material, which is easily discharged. Care, however, should be taken to prevent the caustic from injuring the adjacent skin by the use of rags dipped in vinegar.

(3) Pressure by means of strapping carried over the swelling to the sound parts around has been strongly advocated. An opening should be left for the escape of the discharge.

(4) An expectant treatment with applications of linseed poultice or resin ointment.

After the employment of methods (1) and (2), a mixture of carbolic acid and olive oil (1 to 40), or boracic acid ointment, forms a good application. The pain may be allayed by the addition of the extracts of opium or belladonna to poultices or water-dressings. Plenty of nutritious food should be given, accompanied by alcoholic stimulants when the patient is in a debilitated condition. Dilute sulphuric acid with quinine and iron is beneficial.

Facial Carbuncle. — Ordinary carbuncles occur upon the face, which do not differ in their course from those situated in other regions. Occasionally, however, we see a very acute and fatal affection, which has some resemblance to the ordinary form, and has been described as *Malignant facial carbuncle.* This usually follows the accidental inoculation of some animal poison. Thus, the writer has seen it attack the lip of a woman who had been scratched by a child with severe scarlet fever, and the lip of a man who, after circumcision, had probably conveyed to it some matter from the sloughy wound which followed the operation.

It is generally seen at an earlier period of life than ordinary carbuncle,—e.g. between the ages of twenty and thirty. Beginning as an itching pimple, usually upon the upper or lower lip, the swelling rapidly affects the whole lip, which is soon four or five times the natural size. It is brawny, livid, and very painful. Numerous pustules or vesicles form, especially upon the red surface of the lip. The inflammation extends upwards towards the eye, or downwards towards the clavicle. The eyeball may protrude. Severe pyrexia with rigors accompanies the local disturbance. Pain in the side, bloody sputa, and other indications of lung-implication follow, and the patient may succumb to pyæmic phlebitis in a week from the onset of the malady. In a small number of cases, however, the constitutional symptoms are less severe, and the inflammation is not so diffuse. In these, after free suppuration from several points of the surface, the lip may return to its ordinary dimensions, and recovery may take place.

The disease appears to be essentially a phlegmonous inflammation of the lips following a poisoned wound, and setting up thrombosis in the facial or external jugular veins. The clots are apt to extend upwards into the cranial sinuses, and detached portions may give rise to purulent foci in the lungs. On section of the lip, numerous small abscesses are found, and not a homogeneous slough, as in true carbuncle.

The *Diagnosis* from ordinary carbuncle will depend upon the virulence of the constitutional symptoms, the youth of the patient, the position and appearance of the swelling, its tendency to spread along the veins, and the condition of the subcutaneous tissues when incisions are made. Many have confused the disease with malignant pustule; but in the latter affection the vesicles are close together, and grouped in a ring round a central blackish slough; the swelling is remarkably free from pain, and there is no suppuration. In malignant facial carbuncle the pustules are scattered over the surface of the swollen lip; there is acute pain, and the deeper structures are full of small abscesses.

The *Treatment* is to support the patient with generous diet and alcoholic stimulants, to give large doses of quinine, and to make free incisions into the swollen tissues. These should be subsequently dressed with carbolic acid or some other antiseptic material. N. Davies-Colley.

CARCINOMA.— *Structure.*— A carcinoma may be defined as a tumour composed of epithelial cells, generally contained in alveoli, the walls of which are formed of fibrous tissue. The cells vary in shape and size, and as a rule closely resemble the epithelium of the part in which the tumour has originated. Their shape depends also on the amount of pressure to which they are subjected by the surrounding tissues; they are often multi-nucleated, and increase both by endogenous cell-formation and also by fission. The cells lie closely packed in the alveoli and are not separated from each other by any matrix. The blood-vessels are well-formed and run in the trabeculæ, not between the individual cells, as in the sarcomata. Lymphatics accompany the blood-vessels. The following are the chief groups of the carcinomata.

1. Epithelioma or squamous-celled carcinoma.
2. Rodent ulcer.
3. Spheroidal-celled carcinoma :—
    (*a*) Scirrhus.
    (*b*) Encephaloid.
    (*c*) Colloid.
4. Cylindrical-celled carcinoma; adenoid cancer; adeno-carcinoma.

1. EPITHELIOMA.—*Clinical characters.* Epithelioma, or squamous-celled carcinoma, usually commences after forty years of age. It begins as a warty growth, raised to a varying extent above the surface, and at the same time growing to at least a proportionate extent into the subjacent tissues. It is this ingrowth that gives to epithelioma its typical induration. The growth generally becomes more or less papillated, and after a varying time the central part of the free surface tends to break down and ulcerate. In this manner it increases its area, spreading at the edges and ulcerating in the centre. Its progress is generally accompanied by much pain. The surrounding parts are infiltrated and destroyed by the new growth, which extends with much greater rapidity than does rodent ulcer; the neighbouring lymphatic glands are early affected, and the epitheliomatous mass in them runs a similar course to the original tumour. Not infrequently the glandular tumours increase even more rapidly than does the primary growth, and attain a greater size.

Secondary growths may occur in the viscera, but are comparatively rare. In untreated cases of epithelioma, the duration of life varies with the locality, and in some cases may extend over several years.

Symptoms.—When an epithelial ulcer is fully developed it is of a very irregular shape, with a deeply excavated and irregular base, greyish in colour, devoid of healthy granulations and secreting sanious pus; the edges are raised above the base of the ulcer and also above the surrounding parts; they are warty, sometimes ragged or fissured, and in places apparently undermined. On feeling the diseased part, it will generally be immediately discovered that there is a certain amount of new growth in the tissues, giving a sensation of induration around the ulcer to a varying extent; it will then be seen that it is the tumour itself which has ulcerated, and not the tissue in which it lies.

Diagnosis.—Epithelioma may be simulated by (1) innocent papillomas, (2) primary and tertiary syphilitic sores, (3) simple ulcers, (4) rodent ulcer.

(1) Simple warty growths and papillomas are generally easily separable from the epitheliomas; for in the former the tumour is essentially an outgrowth from the surface with little or no infiltration or hardness of the part from which it springs, with very slight tendency to destructive ulceration of any kind, and with but little vascularity, pain, or tenderness. Even in cases of long standing the lymphatic glands are not diseased. It is chiefly when inflamed or irritated that papillomas bear any strong resemblance to the malignant tumours, and it should be remembered that from the innocent papilloma an epithelioma may spring; if, therefore, there is any reasonable doubt, treatment by excision should not be delayed.

Venereal warts, especially when by pressure they have caused ulceration of the prepuce, occasionally grow in such a manner as to simulate epithelioma. The youth of the patient in most cases, and the history of previous urethritis in addition to the points just enumerated, will generally clear up any doubt.

(2) *Syphilitic Sores.*—Primary syphilitic sores, especially when occurring on the lip, may be mistaken for epithelioma. The youth of the patient in many cases, the very early and very extensive swelling of the glands, the amount of inflammation around, other evidences of syphilis, and the special characters of the sore, will in most instances enable the syphilitic chancre to be readily diagnosed.

Tertiary ulcers on the tongue and elsewhere are sometimes not readily distinguished from epitheliomas. Treatment often clears up the doubt, but it should be borne in mind that an ulcer, originally syphilitic, may become the seat of epitheliomatous new-growth. *See* TONGUE.

(3) *Simple Ulcers.*—Simple fissures on the lips, chronic ulcers on the legs with thickened and raised edges, and, occasionally, simple ulcers on other parts of the body, occasion a slight difficulty in diagnosis, which readily clears up under adequate treatment. *See* ULCERS.

In all cases where there is doubt whether any given ulcer is epitheliomatous, a very small portion of débris from the ulcerated edge may be scraped away and put on a glass slide, in a little water, for microscopic examination. In most cases where the growth is epithelial, the cell-nests typical of this growth will be seen, either entire or in broken masses, in the field of the microscope, affording positive evidence of the nature of the ulcer. If such nests are not seen, their absence does not necessarily prove the innocent nature of the sore.

(4) For diagnosis from rodent ulcer see *Rodent Ulcer* later on.

Structure.—Microscopically, these tumours are found to consist of ingrowths of epithelial cells arranged in the form of papillæ, columns, or cylinders. On any skin or mucous surface these ingrowths may readily be traced to an excessive development of the interpapillary processes of epithelium, which will be found gradually dipping further and further into the subjacent tissues. As these epithelial processes grow more deeply they throw out lateral branches, and, these latter uniting with similar cell-growths from neighbouring cylinders, form a rude epithelial network. At the same time that this ingrowth of cells occurs, a similar outgrowth takes place, and a warty excrescence of epithelium is formed on the cutaneous or mucous surface. As the tumour increases in size, the more superficial and central cells perish and fall away, thus leaving the deeper parts of the epithelioma exposed. Such a condition as this is usually spoken of as 'ulceration,' though there is not present any true granulating surface.

The epithelial cells of which the cylinders are composed are usually large, very irregular in shape, often possessing processes, multi-nucleated, and sometimes evidently in the process of proliferating by endogenous cell-formation. Embedded in these columns are a varying number of cell-nests, sometimes very numerous in any individual specimen, in other cases scarce, but rarely entirely absent. They appear to be composed of one or more central cells of a rounded shape, and often smaller than their neighbours; sometimes these central cells appear to have degenerated, and their place is taken by broken-down, granular débris. Immediately around the centre are small crescent-shaped cells, with their concavity inwards, and outside these again are layers on layers of similar-shaped, but larger, cells. It is probable that the nests are formed by the very rapid proliferation of cells at various foci in the tumour, that the cells first formed at any focus are pushed towards the periphery by the constant and rapid growth in the centre, and become flattened or crescentic through the resistance offered by the surrounding tissues. The chief significance of a nest is that it indicates rapid cell-growth, and therefore when occurring in the deeper parts of the skin is diagnostic of epithelioma, for no such formation occurs under other circumstances in this situation; although nests may be present normally, though rarely, immediately beneath the free surface of the epidermis. Around the ingrowing columns there is generally evidence of irritation of the tissues into which the tumour is making its way, and each column is more or less surrounded by numerous leucocytes.

Locality.—The most common situations for epitheliomata are at the junctions of mucous and cutaneous surfaces. They occur on the lips—almost always the lower lip—and other parts of the face, the tongue, the larynx, the œsophagus, the rectum and anus; on the penis, the scrotum—as 'sweep's cancer'—the vulva, the os uteri; more rarely on the skin of the extremities or trunk, especially in the site of old scar-tissue or of sinuses long discharging, and occasionally on the scalp and ear, in the antrum, and in the bladder. Epithelioma never occurs primarily in bone, but, as in the case of the jaw-bone, it may extend into osseous tissue from a contiguous mucous or skin surface. For *treatment, see* MALIGNANT TUMOURS.

2. RODENT ULCER. — *Clinical characters.*—Rodent ulcer occurs late in life, but may certainly appear as early as forty years of age or even earlier. Its common situation is the face, preferably the inner angle of the eyelids. Typically, it commences as a small wart, the centre of which ulcerates; the growth of the wart and the spread of the ulceration progress with about equal rapidity, so that at no time is there any large amount of new-growth; frequently the ulceration heals in one place while it spreads in another; the scar, when formed, is liable to again break down.

The growth of a rodent ulcer is essentially slow, yet the rate of its progress differs much in different cases. Sometimes, after an interrupted course of fourteen or fifteen years, the whole extent of the ulcer is not greater than could be covered by a half-crown piece, whilst, in other cases, large portions of the face may be destroyed within five or six years. The growth appears to extend most rapidly when it occurs at a relatively early age.

When fully developed, a rodent ulcer is a flattened growth of an irregular shape, with a grey, smooth, and glazed base, devoid of healthy granulations, discharging watery pus, cicatrised here and there, with edges raised above the level of the ulcer and of the surrounding parts. Rodent ulcer never causes glandular infection, though the glands may become inflamed, and even suppurate. But, although the above description is true of typical cases of this disease, it is a fact that a rodent ulcer may, though very rarely, attain a considerable size without ulcerating at all, the surface remaining warty and tuberous.

At first a rodent ulcer tends to spread superficially, but, when it reaches bone, its progress is much more rapid, and the osseous tissue is quickly excavated and removed. Thus, in advanced cases, a great part of the skin of the face, the eyeballs, the nasal cartilages and bones, and portions of the calvaria may be entirely destroyed, so that the patient comes to present a most hideous appearance. Yet, even in this condition, life may be prolonged for years, for the distant viscera never become the seat of disseminated growths.

Diagnosis.—The diagnosis must be made from (1) Epithelioma; (2) Lupus; (3) Syphilitic ulcers.

(1) Rodent ulcer must be more especially separated from epithelioma. The first and great difference is found in the much slower progress of rodent ulcer; roughly speaking, epithelioma will grow as much in a month as a rodent ulcer in a year. Yet, here also care is necessary, for epitheliomas may originate in warts or pimples of long standing, so that a patient may, unless carefully questioned, unintentionally mislead the surgeon who asks him how long he has had the disease. In rodent ulcer, the ulcerated surface cicatrises in parts; epithelioma never cicatrises; but it must be remembered that in some rodent ulcers the surface is warty rather than ulcerated, though this is quite the exception. Rodent ulcer never affects the glands, epithelioma, after a longer or shorter period, almost invariably does. The amount of new-growth is generally much greater in epithelioma than in rodent ulcer, and the surface is more warty. Rodent ulcer does not occur in the most favourite sites of epithelioma.

(2) From ulcerative lupus rodent ulcer may be diagnosed as follows:—Lupus almost always *commences* before adult life, though it may *recur* in old age. It commonly occurs in strumous subjects. There is no evidence of warty new-growth; around the edge of the ulcer there are sometimes small tubercles which, by their breaking down, cause an increase in the extent of the sore; under constitutional treatment a healthy granulating surface may result, and a sound scar be formed.

(3) Tertiary syphilitic ulcers may be diagnosed from rodent ulcer by the early age of the patient in many cases; the evidences of syphilis; the presence of pigmented scars around; the much greater rapidity of the ulceration; the semicircular or serpiginous shape of the sore; the absence of all new-growth; and the success attending the employment of anti-syphilitic remedies.

Structure.—A rodent ulcer is a growth composed of embryonic epithelial cells, and must, therefore, be included amongst the carcinomata. Microscopically, it is found to consist of an overgrowth of epithelial cells in the deeper portions of the skin, often apparently commencing in the sebaceous glands. The growth invades the subcutaneous tissues in the form of large, flask-shaped ingrowths, frequently separated from each other by several normal papillæ and interpapillary processes of epithelium. The cells of which these ingrowths are composed are evidently epithelial, but, nevertheless, differ very markedly from those of the rete Malpighii and of the squamous epitheliomata, chiefly in being much smaller. In their further growth they differ again from the cells of epithelioma in their tendency to become vacuolated, and thus to form spaces in the centre of the ingrowing masses, and in that, with the most rare exceptions, they never form cell-nests in the epithelial columns, as do the cells of epithelioma. In rodent ulcer perfectly normal inter-papillary processes may often be found in the midst of the new-growth. This is never the case in epithelioma. The growth in rodent ulcer probably springs from the glandular epithelium in some of the appendages of the skin, and it is owing to this difference in origin that the tumour-growth differs from that of epithelioma, in which the growth always commences in the surface epithelium.

Locality.—Rodent ulcers are almost invariably met with on the face above the level of the mouth; perhaps their most common seat is the side of the nose and the inner angle of the orbit. They are sometimes found upon the ear and the scalp. For *treatment*, *see* Malignant Tumours.

3. Spheroidal-Celled Carcinomas.—The spheroidal-celled carcinomas are subdivided into *a.* Scirrhus; *b.* Encephaloid; *c.* Colloid.

Clinical Characters.—Both scirrhous and encephaloid cancers are most commonly met with between the ages of forty and sixty; they may occur, however, either earlier or later than these limits. Typically, a *scirrhous carcinoma* commences as a firm, nodular mass, which is at first painless, and so may attain considerable size before being noticed by the patient. An examination at an early stage of its growth reveals the following characters:—A tumour of variable size, surface irregular and nodulated, very hard indeed to the touch, often fairly movable in the tissue or gland in which it lies—e.g. in the breast—not very painful or tender; glands, if enlarged, very hard and freely movable. The rapidity of growth varies greatly, so that in some cases of so-called atrophying scirrhus the tumour may be no larger than a walnut after some three or four years' growth. Such cases are almost confined to the old, and are rare. After a varying time the tumour becomes fixed to the surrounding tissues; the skin becomes dimpled, puckered, and adherent; the patient suffers lancinating or stabbing pain, and the tumour is tender on pressure; the glands which are affected alter in character, just as does the original growth. *See* BREAST, Diseases of the; MALIGNANT TUMOURS.

Secondary growths in the viscera are common in cases of scirrhus, and the bones sometimes become brittle and fracture spontaneously. It is doubtful, however, whether the fragility of the bones exists except in connection with the development of cancer-elements in their structure. Sometimes scirrhous carcinomas are primarily multiple.

Medullary carcinomas grow much more rapidly than the scirrhous tumours, and early become adherent to the surrounding parts. They attain frequently a great size, and to the touch are soft or elastic, and sometimes fluctuating in places where they have undergone cystic degeneration. In their further development they run a course similar to that described as typical of the growth of malignant tumours in general. *See* MALIGNANT TUMOURS. Metastatic growths are frequent, and the patient often succumbs within a year from the commencement of the disease.

The clinical characters of the *colloid cancers* are identical with those of the other spheroidal-celled carcinomas, the type varying in different cases, and resembling in some cases a scirrhous, in others a medullary, growth.

Diagnosis.—These tumours, when occurring in secreting glands, as is usually the case, must be distinguished from (1) the sarcomata; (2) cysts; (3) abscesses.

(1) From the sarcomata they may be diagnosed (*a*) by the greater age of the patient in whom they (the carcinomata) usually occur. Thus sarcoma of the testis occurs in the young, and even in infants; carcinoma in middle age or late in life. (*b*) By the presence of glandular affections in the carcinomas when the breast is the organ diseased, and by the absence of glandular affection in all sarcomas of the same part. (*c*) By the greater softness and more marked lobulation of the sarcomata, by the absence of puckering and retraction of the skin, and also of the nipple when the breast is the seat of sarcomatous growth. Carcinomas rarely grow in the parotid. In the testis it is often impossible to decide the true nature of a malignant growth.

(2) From deeply-seated cysts and (3) chronic abscesses of the breast the diagnosis is often difficult, and, in some cases, impossible. The age of the patient, a recent pregnancy or miscarriage, the greater softness and tenderness of any enlarged axillary lymphatic glands, œdema of the skin, with widely diffused tenderness, and, perhaps, an indistinct sense of elasticity or fluctuation, will all make probable the presence of a chronic abscess. In cases of doubt, exploratory puncture should always be resorted to.

Spheroidal-celled carcinomas sometimes commence in the skin, which rapidly gives way, and allows of the formation of a 'cancerous' ulcer with a fungating growth. Diagnosis must be made from inflammatory swellings and from the sarcomata. The rapidity with which the tumour increases, together with its hardness, the affection of glands, and the absence of suppuration, will generally admit of a diagnosis being readily made. *See* ULCERS.

Structure.—The spheroidal-celled carcinomata spring from the epithelium of the various secreting glands.

The tumour always commences by a proliferation of the glandular epithelium. The cells, increasing in number, first fill the acini and ducts, and then, continuing to proliferate, extend into the surrounding tissues. There, their presence causes a certain amount of irritation and consequent proliferation of the connective-tissue elements, and they thus become surrounded by leucocytes. In the usual course of events the leucocytes become developed and form connective-tissue bands around the growing epithelium cells, which in this way become shut up in spaces or alveoli. Later on, this newly-formed fibrous tissue tends to contract and become more dense, in exactly the same manner as does scar-tissue; and as the oldest parts are always the most central, it is in the centre that the firmest portion of the tumour is to be found.

Considering that a certain amount of time is requisite in order to allow of the formation and contraction of this fibrous stroma, it will readily be understood that it is most abundant in the more slowly-growing tumours. It is, therefore, most plentiful in scirrhous carcinomata. On the other hand, in the rapidly increasing encephaloid growths, the walls of the alveoli are extremely thin.

(*a*) SCIRRHOUS CARCINOMA.—*Examined microscopically*, a scirrhous carcinoma is found to consist of epithelial cells lying in a connective-tissue stroma composed of interlacing bands of fibres. The spaces, or alveoli enclosed by these bands, are very irregular both in shape and size, and are smaller towards the centre of the tumour than at its periphery. Lying within the alveoli are numerous epithelial cells of different shapes, often undergoing fatty degeneration in the more central parts of the growth. Where the stroma is most loosely arranged, as at the edge, the cells are larger and more evidently epithelial than in the central and denser portions of the tumour; they often possess several nuclei and nucleoli.

In the larger alveoli as many as thirty or forty, or more, cells may be massed together; whilst in other parts they lie in single file, in groups of two or three, amidst bundles of connective tissue. Intimately mingled with the constituents of the tumour, as just described, are numbers of small round connective-tissue cells and young connective-tissue fibres; they are most abundant at the periphery of the growth.

To the naked eye a scirrhous cancer presents itself in its most typical form as an opaque, white, fibrous mass, very firm and dense, concave on section, and with an irregular margin. At the edge of the tumour there will often be seen small masses of the surrounding fat or other normal structures which are being infiltrated by the tumour, and which have, as it were, been entangled by the new-growth preparatory to being absorbed. There is no attempt at encapsulation. The surrounding tissues are puckered and drawn in towards the tumour mass, which sends into them irregular branching processes. On scraping, the tumour yields a milky juice.

In other cases the tumour is more succulent and lobulated, and not so definitely fibrous; whilst in rare instances there is a general infiltration of the tissue with new-growth and no very definite tumour is found. The appearance of a scirrhous cancer will further differ according to the amount of degeneration it has undergone, so that in some instances cysts containing a bloody fluid will be found in the centre of the growth. Where the tumour has developed in the breast, it is very common to find the remains of the ducts in the midst of the new-growth filled with inspissated secretion, which may be squeezed out in small masses somewhat similar to the secretions found in the sebaceous glands in acne.

Locality.—By far the most common seat of scirrhous carcinoma is the female breast; but this form of cancer is also found to occur primarily in the œsophagus, the stomach—especially at the pylorus—the bladder, the rectum, and the skin.

(*b*) ENCEPHALOID CARCINOMA.—*Microscopically examined*, an encephaloid carcinoma consists of an alveolar stroma containing masses of epithelial cells. In a typical case the alveolar walls are very thin, and are frequently composed of spindle cells and young, half-developed fibres. The general outline of the alveoli is more rounded, and their size more regular and much larger than in the case of scirrhus. The contained, numerous, closely-packed epithelial cells are large, with clear cell-bodies, many nuclei, and a large number of nucleoli. The bulk of the tumour is cellular.

To the naked eye, on section, an encephaloid carcinoma shows a soft, greyish or brownish-grey, brainlike mass, frequently containing cysts, very readily breaking down into a pulp, and nowhere bounded by a capsule.

Locality.—The female breast and, more rarely, the testis, stomach, bladder, rectum, and skin. Encephaloid carcinomata are much more rarely met with than the scirrhous variety. Their supposed frequency depended on their having been only of late years separated from the brainlike sarcomata.

(*c*) COLLOID CARCINOMA.—This is but a name given to a spheroidal-celled carcinoma, the cells and stroma of which have undergone degeneration. The alveolation is usually well-marked, but in places the fibres have become swollen and indistinct or hyaline; occasionally two alveoli run together through excessive degeneration of their walls. The cells are often indistinct and swollen, with the exception of their nuclei, which are generally well-marked and stain deeply. Frequently the nuclei alone can be distinguished, but in other cases the cell-body may be seen distended with colourless, homogeneous, colloid matter.

To the naked eye a colloid carcinoma presents a very typical appearance, looking like an irregular meshwork, the spaces of which are filled by a clear, jelly-like, or slightly opalescent, gelatinous substance. Towards the periphery this appearance is less marked. These tumours are never encapsuled.

Locality.—Colloid carcinomas are most common in the stomach, but are found also in the intestines, the breast, and very rarely in other parts of the body.

4. CYLINDRICAL-CELLED CARCINOMA OR ADENOID CARCINOMA. — *Clinical characters.* — Cylindrical-celled carcinomas vary much in their clinical course and characters. In some cases they exist for many years without attaining any great size, without affecting the neighbouring glands, and without becoming disseminated. In other cases, they grow rapidly, fungate and bleed, affect both glands and distant organs, and rapidly destroy life. It is not possible to say, from a microscopical examination of such a growth, what course it will run.

The diagnosis of these growths will be found discussed in the article on the diseases of the RECTUM.

STRUCTURE.—These tumours, like the spheroidal-celled carcinomata, originate in the secreting glands. Microscopically examined, they are seen to be composed of tubules lined with columnar epithelium, arranged so as to form a central lumen, after the manner of a simple tubular gland, and in addition to this growth, which possesses the appearance of a simple adenoma, there is generally present a considerable overgrowth of epithelium, not arranged after the glandular type, but occurring as masses of cells grouped in greater or less number in an alveolar stroma after the manner of a scirrhous cancer. Between the latter typical carcinomatous structure and the adenomatous growth all intermediate steps can be readily traced.

The structure of the alveoli does not materially differ from that already described as occurring in the spheroidal-celled carcinomas, but the cells are columnar or cylindrical in shape, and are generally numerous, large, and well-developed.

To the naked eye, the cylindrical-celled carcinomas present themselves as villous or papillary tumours of whitish hue, infiltrating the deeper tissues to a varying extent, and never encapsuled.

Locality. — Adenoid carcinomas occur most frequently in the rectum; much more rarely in the superior maxillary bone, the uterus, the bladder, and the stomach.

MELANOTIC CARCINOMAS. — Deposit of pigment in carcinomatous growths is rare, and may be said to be limited to a few cases of epitheliomata. Almost all melanotic growths are sarcomas. *See* SARCOMA.

For the Etiology and Clinical characters of malignant tumours, and the Treatment of the carcinomata, *see* MALIGNANT TUMOURS.

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CARDEN'S AMPUTATION. *See* KNEE-JOINT, Amputation at the.

CARIES implies molecular death and disintegration of bone, attended with suppuration. The same kind of changes which occurs in ulceration of the soft tissues, is expressed by the term caries when bone is the part under consideration. The word has been used in very various ways, as, for example, in 'caries sicca,' to express inflammation of bone without suppuration, and it has thus led to considerable confusion. But it would be far better to call such cases ostitis, rarefying ostitis, tubercular ostitis, and so forth, using the term which seems most appropriate for each, and to limit the term 'caries' to those cases in which suppuration has occurred. It may be understood from this that ostitis not unfrequently terminates in caries.

Causes.—The same causes that give rise to inflammation of bone, and that are considered under OSTITIS, may produce caries. Some slight injury is often the exciting cause. But struma or tubercle is generally present, and these two diseases may be looked upon as the special conditions—if indeed they are distinct from one another—which are mainly responsible for the commencement of caries. Caries is also sometimes caused by syphilis, and is then peculiarly intractable, being generally the result of a broken-down gumma in the periosteum and superficial layers of the compact bone. It would, in this superficial variety of the disease, be very properly described as ulceration.

Pathology.—Caries is met with chiefly in the short spongy bones, such as those of the carpus, tarsus, and the vertebral column, or in the cancellous tissue of the articular extremities of the long bones. The first stage of the process is probably 'rarefying ostitis,' although some pathologists assert that it begins as a fatty degeneration of the bone-cells in the lacunæ. According to this theory, the trabeculæ being killed by the death of their cell-elements act as foreign bodies, and set up suppurative inflammation around them. But whatever be the primary condition—a condition which need not here detain us—inflammation of a low and chronic kind is eventually established. The periosteum becomes much thickened, highly vascular, and loosened from the bone. Its under surface is rough and covered with a layer resembling granulations which fit into the enlarged openings of the Haversian canals. The latter are dilated and their connective tissue infiltrated with inflammatory exudation, which develops slowly into granulation-tissue. The bone thus becomes more open and spongy, so that the cortical part resembles cancellous tissue. Pus, thick and curdy, is very slowly formed, and finally—perhaps after many months—makes its way to the surface as a chronic abscess. In this rarefying ostitis, some parts of the bone may not have melted away so quickly as others, and, being cut off from their nutritive supply, may perish. When this occurs, and sequestra are found in a carious cavity, the condition is called 'caries necrotica.' This is not uncommon in tubercle and syphilis. In some cases very little pus is formed, and the cancellous spaces enlarged by the absorption of their bony walls are filled with vascular granulation-tissue. This fungating form of caries ('caries fungosa') is especially common in the spongy bones, and in the epiphyses of the long bones, where it often opens into the neighbouring articulation, as is described in the article on joint-diseases. After a varying length of time, the fungating granulation-tissue undergoes fatty degeneration, which is then followed by softening and suppuration. Fatty degeneration and softening do not, however, necessarily ensue, and the cavities may remain filled for a variable length of time with the pink gelatinous granulation-tissue, which is again slowly absorbed, leaving the bone smaller and shorter than it was before. This variety, which is called 'caries sicca,' is seen occasionally in the articular extremities of a long bone, and produces considerable shortening of the extremity without suppuration. In the early stage of almost all these forms of caries, at a time when the disease corresponds chiefly to the rarefactive type of ostitis, some new bone is generally produced in the neighbourhood of the inflamed area, so that the bone appears enlarged.

Symptoms.—The symptoms in the early stage of the disease may be those only of ostitis, which will be found described under that heading; or the increased size of the part may be less evidently due to an enlargement of the bone itself than to a deep-seated swelling of the tissues in immediate contact with it. The presence of pain at night, the persistence of the tumefaction, and the tenderness on deep pressure, will then be the chief points indicating the presence of inflammation of bone which may terminate in caries. Often, however, a swelling which proves on examination to be a chronic abscess, is the first sign which the patient has himself recognised of the disease. The mere fact of the accidental discovery of such a chronic abscess will arouse the surgeon's suspicion of the case being one of caries.

Occasionally, the patient comes under observation for the first time with the sinus, which has resulted from the opening of the abscess already formed. Then the probe decides at once upon the nature of the case. It may sometimes be a little difficult to reach the bone, particularly in cases in which the sinus has existed for a long time, and the bone is not superficial. If, after a careful and fair trial with the probe, bent and moved in various directions, the bone has not been touched, and the impression is left on the mind that the end of the sinus has not been reached, then the fistulous opening may be enlarged to facilitate the movements of the probe, or Sayre's vertebrated probe may possibly be of service, but the writer has not much confidence in the use of this latter instrument. The character of the sinus and its discharge may also throw some light upon the nature of the case. The button-shaped, pouting granulations, which surround the opening, too surely indicate the presence of diseased bone at the bottom of the sinus, and in caries they are generally more fungating and œdematous than in necrosis. The discharge is also thin and watery, containing frequently small, gritty particles of bone; it may also be offensive if putrefaction be not prevented by suitable treatment. The probe, as it strikes upon the carious part, fails to elicit the clear, sharp, ringing sound which is generally noticeable in the case of necrosis, but conveys the impression that the bone is rough and bare. Being also spongy and fragile from the nature of the disease, it not uncommonly gives way before the pressure of the probe.

Treatment.—The general treatment in caries is more than usually important, for the operations which are undertaken for its relief are not so uniformly successful as in other diseases of bone. If there be any grounds for suspecting syphilis to be the cause of the disease, iodide of potassium alone, or in combination with mercury if the former fail, must be given in gradually increasing doses, in the manner described under Periostitis.

Struma or tubercle being, however, the most frequent cause of caries requires more than a passing mention as to its treatment. Cod-liver oil probably holds the foremost place amongst the constitutional remedies in caries as in other strumous or tubercular affections. Iron and the iodides may also be of service. But, in the young, change of air, and especially to the seaside, will often bring about a successful result when no other treatment seems of any avail. It is truly astonishing to see the progress such cases make when they are sent from a London hospital to the Margate Infirmary.

As far as local treatment is concerned, rest and free openings for the discharge are the first and most important indications. Rest should be obtained, where it is possible, by a splint, and in the case of the foot by a knee-rest, so that the patient may not be confined to bed. Incisions should be made in dependent places when the discharge does not seem to escape with sufficient freedom. If the case come under observation before the abscess has opened, the incisions and subsequent dressing should be conducted with antiseptic precautions. A drainage-tube should be inserted, and some antiseptic absorbent wool will generally be found to be the most convenient form of dressing. Sufficient time having been allowed to elapse for these general and local remedies to take effect, the question arises what operation, if any, should be adopted; and here considerable latitude must be given to differences of opinion, according to the special features of the case. Some surgeons hold that there is very little to be gained by gouging away the diseased part; that if it becomes absolutely necessary to interfere on account of the exhaustion produced and the intractable nature of the disease, the choice of operation lies between excision of the whole bone affected, and amputation of the limb. Without going thus far, we may infer, from this opinion, that gouging away the diseased part of the bone is not held in very high favour. Such partial operations on bone were, in former days, peculiarly prone to be followed by pyæmia. The latter is not so frequent now that every surgeon makes thorough and effectual endeavours to prevent the occurrence of decomposition in the discharge which would otherwise necessarily ensue. The disease must, however, be chronic before such an operation is undertaken.

The limb should be rendered bloodless by Esmarch's bandage, so that the limits of the disease may be clearly defined. This is more essential in caries than in necrosis, for the diseased area is surrounded by rarefied bone, which is not easily distinguished from caries. The difference between the two is generally indicated by the crumbling non-vascular, almost white condition of the latter, whilst the healthy, although inflamed, bone, is firmer and more resistant to the gouge, and on removal will be found pink and vascular. Gouges of various shapes and sizes may be required, and Volkmann's sharp spoons may also be of great assistance, especially in the removal of granulations, which should be all cleared away. The cavity should then be sponged out with chloride of zinc from gr. xx. to gr. xl. ad f℥j., and some absorbent dry dressing, such as iodoform or salicylic wool, applied. This will not require changing for some days, and, after the first redressing, may generally be left untouched for a week.

Instead of using the gouge, some surgeons prefer the actual cautery, and Mr. Pollock has recommended the application of sulphuric acid, diluted at first with an equal quantity of water, and then more nearly pure. As soon as the eschar thus formed can be removed, the sulphuric acid is again applied, till a healthy surface of granulations is obtained. Mr. Holmes speaks favourably of this treatment, as also of that by the actual cautery.

Where the small bones are the parts diseased, such as those of the tarsus or carpus, excision, with or without the periosteum, is often the best operation, if the caries involves the greater part of the bone. This is especially the case in the os calcis; but if more than one bone is involved, amputation will probably be required.

The other small bones, entering into the formation of ankle- and wrist-joints, are more properly considered under Joints, Diseases of.

Amputation is very rarely required for caries, except in the case of joints, the diseases of which are considered in another article. H. H. Clutton.

CARIES OF THE SPINE (Pott's Disease).—This is especially a disease of childhood. It may begin in the first year of life, and even, it is stated, *in utero.* Most cases are under sixteen years of age. It has been known to begin at seventy years (Ogle). Both sexes are said to be equally affected, though the writer's figures give a preponderance of twenty-five per cent. to males.

A remote constitutional cause can be generally traced in scrofula or tubercle; the exanthems, especially scarlatina and measles. In adults, syphilis in the form of gumma (Fournier), or following syphilitic pharyngitis. An immediate cause is often local injury, from falls, blows, strains; while certain occupations seem, at times, to account for it, e.g. those of well-sinkers, signalmen, compositors. Violence is almost necessarily applied indirectly to the vertebral bodies, which are more subject to strains than other forms of injury, at their unions with the discs.

Pathology and Course.—Caries of the spine begins usually at the junctions of the bodies of the vertebræ and the intervertebral discs. Even in advanced cases the laminæ and spinous processes escape. In atlanto-axoid disease it begins as a synovitis of the joint. The onset is insidious, the course chronic, occasionally only rapid and acute; but the pathological conditions in no way differ from those of caries of the other cuboid bones, or of the spongy ends of long bones. Since the flat surfaces of the vertebral bodies are epiphyses, caries may be regarded as commencing as an epiphysitis or articular ostitis.

Caries destroys the intervertebral discs and adjacent bone above and below, thus contrasting with the absorption due to pressure of aneurism—also a cause of angular deformity—in which the cartilages remain intact after the bone has disappeared. The bone-destruction may be quite superficial, and be only suspected when abscess has formed; it may, though rarely, begin in the spinal canal on the posterior surfaces of the bodies under the posterior common ligament. Any matter thus formed lies outside the theca vertebralis. At times there is necrosis as well as caries. Sequestra may be discharged externally, or be found at the autopsy in the cavity formed in the spine, and unsuspected during life.

Suppuration does not necessarily accompany spinal caries; but it may exist, yet never be seen, during life (e.g. it may form an abscess in the posterior mediastinum). Its extent is not proportionate to the apparent extent of disease, nor can it be predicted in any case. It may be the earliest objective sign, or it may be the last symptom in a case. The writer's figures show visible suppuration in about twenty-five per cent. of all cases.

Where suppuration is absent—*caries sicca*—the bodies of the vertebræ, in lieu of being destroyed so as to produce a larger or smaller continuous chasm in the front of the spine, are seen sometimes to be honey-combed by the carious process and filled with granulation-tissue, a condition known as *myelitis granulosa.* Extensive disease may then exist without deformity, the bodies being perforated rather than destroyed. But little practical good results from a distinction between suppurative and non-suppurative caries, for, as stated above, the absence of visible suppuration does not preclude the pathological probability of its existence. Most frequently there is but one focus of disease, and this involves one or many vertebræ, but two or more may be present in different parts of the spine. They may be contemporary or successive.

In proportion as the bodies and discs are destroyed, so will the second stage of the disease be reached—that of deformity or *angular curvature*—but deformity is absent where the caries is only superficial. The weight of the superincumbent trunk and limbs causes the bone above the cavity in the bodies, formed by the disease, to approach that below it until they meet; the spines of the intervening diseased vertebræ are protruded posteriorly as a knuckle or boss. Where a vertebral body is only partly destroyed or only softened by inflammation, the pressure described will cause it to become wedge-shaped, the base of the wedge being posteriorly, and its spine will unduly project.

The largest and most quickly formed bosses are to be seen in the dorsal region, simply because in the mid-cervical and lumbar regions there is a natural concavity of the spine backwards, which must be obliterated before a posterior projection can occur, but the dorsal spine is naturally convex posteriorly. In the cervical region disease of the third or fourth vertebra shows itself rather as a thickening than a distinct boss, and in the last three lumbar vertebræ a boss is rare. These vertebræ are so firmly interlocked, and are so broad, and their large transverse processes give such powerful muscular attachments, that the back can be held rigid and straight.

The most common seat of disease is between the first lumbar and twelfth dorsal vertebræ (Hueter). The writer's cases show the dorsi-lumbar region (second lumbar to tenth dorsal) as most frequently diseased, and, after that, the following is the order of frequency: dorsal, lower lumbar, cervical vertebræ, cervico-dorsal (seventh cervical to third dorsal), atlanto-axoid articulation.

In the occipito-atlantoid, atlanto-axoid, and sacro-coccygeal regions disease begins as a synovitis of the respective joints. It is usually chronic, but death in two weeks from pyæmia, after acute synovitis of the atlanto-axoid articulation, is recorded. In the atlanto-axoid articulation the left side is more frequently affected than the right (Rust). From the joint the disease spreads to the arch of the atlas and body of axis, portions of which—or even the entire odontoid—may come away as sequestra through a post-pharyngeal abscess. The deformity in atlanto-axoid disease is peculiar. Where both joints are diseased the head and atlas slide bodily forward upon the axis, the spine of the axis forming an apparent boss, with a deep sulcus between it and the skull. Where one joint is affected that side only is projected forward, and hence the face looks to the opposite or sound side.

Narrowing of the spinal canal, as the result of deformity, is not seen in angular curvature. The anterior wall of the canal being gone, there is, even in extreme curvature, positively more room for the accommodation of the cord, whilst the chronicity of the change gives time for the cord to accommodate itself to the altered shape of its chamber. But in atlanto-axoid disease, where the atlas slides forwards upon the axis, the canal is narrowed, the posterior arch of the atlas gradually approaching the odontoid process, and as gradually are the functions of the cord interfered with, and death results. Yet extreme narrowing, if gradual, is not necessarily fatal; a man has lived years with only a quarter of an inch between the arch of the atlas and the odontoid, and that without any subjective symptoms; a lad, æt. fifteen, has lived some time, though with gradually increasing paralysis, in whom, at death, the canal at this point measured but three lines in the same direction (Paget).

Angular curvature in the cervical and cervico-dorsal regions causes dyspnœa from the forcing of the chin on to the sternum; in the mid-dorsal region it deforms the chest, reducing its vertical depth and interfering with the action of heart and lungs; in the lower dorsal region it bends the thorax upon the abdomen and interferes with the digestive organs, causing mechanical dyspepsia and frequently intercostal neuralgia.

The formation of pus causes fresh pathological states. It may appear externally as abscess (*see* PSOAS, LUMBAR, RETRO-PHARYNGEAL ABSCESS), or it may remain concealed behind the peritoneum or in the posterior mediastinum, and may be unsuspected till it breaks into a viscus or serous cavity. It may occur at any period of the disease, or not at all; or, as a residual abscess, when apparently complete repair has taken place.

Interference with the functions of the spinal cord is specially correlated to the presence of pus. Chronic meningo-myelitis is the result of caries and suppuration in the proximity of the theca vertebralis, though pus may travel along the canal at times without doing any harm. The condition is one of thickening of the meninges with caseation, with inflammation of the cord, or even complete suppurative disorganisation. This is not confined to the level of the bone-disease; it spreads upwards and downwards; lumbar caries has been known thus to produce fatal cerebro-spinal meningitis. Acute cerebro-spinal meningitis in caries of the spine is always, or nearly so, due to miliary tubercle.

The paralysis of spinal disease is motor, and explained by the proximity of the disease to the anterior columns of the cord; in advanced cases anæsthesia may follow; paralysis of sensation is unusual as an early symptom; it then only amounts to numbness. Paralysis is due to inflammation in meningo-myelitis, or to pressure from confined pus or blood (e.g. ulceration into vertebral artery), and in atlanto-axoid disease, to the presence of displacement. It is rarely complete at first; it is ingravescent; it may affect one limb or be symmetrical, or in cervical disease may involve an arm and the opposite leg. In the paraplegic form the rectum and bladder usually escape; the patient, though unable to walk, retains power over his evacuations. Evidently recovery depends upon the cause of the paralysis. Cases due to pressure are the most favourable: paralytic attacks may be repeated, recovery occurring between each; when sensation is lost it is recovered before motion.

Death in spinal caries results often from exhaustion by suppuration or septicæmia, especially where abscesses have been opened non-aseptically; from hæmorrhage due to abscess opening into an artery, as the vertebral or iliac; from suppurative peritonitis or pleurisy; pneumonia; tuberculosis; amyloid disease; meningitis; and the sequelæ of paralysis. In atlanto-axoid disease, gradual or sudden pressure upon the cord from dislocation of the bones, and suffocation from the bursting of a post-pharyngeal abscess, are special fatal results.

Symptoms.—It is of vital importance to recognise spinal disease before the advent of the later stage of angular curvature; yet many cases do not seek relief till a boss is developed, the premonitory signs having been so slight. Pain is generally an early symptom, of a dull, aching, gnawing character, situated in the back, with a sense of back-weakness. The pain is aggravated by movement, pressure, or jarring, and quickly relieved by complete rest. It is accompanied at times by muscular spasm and cramp; the former in cervical disease causing wryneck from rigidity of the sterno-mastoid muscle, the latter, when in the legs, producing a peculiarity in the gait. Neuralgic pains are referred along the course of the nerves near the roots of which the disease exists, hence sciatica and intercostal neuralgia; in mid-dorsal disease there is pain at the pit of the stomach, or a sense of constriction round the belly; in cervical disease, neuralgia of the brachial plexus, and in the scalp along the great occipital nerve (Hilton).

Children with early caries are seen lolling about, undesirous of play, uncompanionable, out of temper, and clearly show they wish to be left alone. When standing they hold on to the furniture, or even rest their hands and chins on the edge of the table. Their complaints of pain are very vague: it may be situated in the back, but as likely as not in the legs or belly, and from standing with one hand on the thigh to give support to the back, are usually suspected by parents of hip-disease, or all is explained as 'growing pains.' They strut instead of walking, which is due to holding the back stiff to prevent movement of the inflamed parts; but cramp or spasm of the calves sometimes gives a peculiarity in walking. When stooping to pick up an object, one hand is placed on the thigh, and the child reaches the ground with the other hand by bending the knees, or may at once kneel outright.

Firm pressure over the vertebral spines reveals a tender spot; and pain at the same place is manifested by pressing on the patient's head or shoulders, or by jarring the back; spasm of the erector spinæ is also present, and occasionally local heat and hyperæsthesia of the skin to heat and cold. By lifting the shoulders of the patient, and removing the weight of the trunk from the diseased bone, the pain is usually much relieved. When in later stages angular deformity is present, the case is easy to recognise; the boss is formed of one or of several spinous processes, and is accompanied by the thoracic and abdominal deformities already mentioned, when in the dorsal region.

In the cervical region special symptoms are present. Muscular spasm causes wryneck; from the forward position of the head the patient appears short-necked, and either a boss or thick convexity of the spine is felt posteriorly. Though commonly the chin approaches the sternum, sometimes in young children the head is thrown spasmodically backwards; the whole body is turned in lieu of rotating the head (but this is not confined to atlanto-axoid disease), and expiration is accompanied by a characteristic grunt; when dysphagia is also present, retro-pharyngeal abscess must be looked for. When standing or sitting the head will be supported by the hands. In disease of the atlanto-axoid articulation grating on forced rotation of the head may be at times felt, and the whole head is preternaturally forward, or the face looking to one side, for reasons given above. In advanced disease from gradual narrowing of the canal there is dyspnœa, with a sense of impending death, making the patient afraid to lie down; the supine position may even cause death by pressing the head forwards, were not a small pillow placed under the nape (Hilton). Equally dangerous is it to allow the patient to lean forwards.

The paralysis of spinal disease in children is often early overlooked or ascribed to clumsiness; hence, stumbling constantly in walking, and falling unduly at play, should excite suspicion. In adults the gait becomes shuffling, and numbness, neuralgia, and persistent cramp are at times the precursors of paralysis. Paralysis appears at all stages of the disease, and is, at times, the first symptom that attracts attention; there may be no objective sign of disease, but local tenderness in the spine will be present on careful examination.

When, accompanying paralysis, there is much rachalgia, with spasm of muscles, shooting pains and cramps, meningitis is likely to be present. When, later, the paralysis is complete, with loss of sensation and paralysis of the sphincters, profound changes in the cord from myelitis or pressure must be suspected. A sudden onset of complete paraplegia, with fever, delirium, cerebral symptoms, and optic neuritis, ending fatally, in the course of spinal caries, points to cerebro spinal meningitis due to acute tubercle.

Diagnosis.—In the later stage of angular curvature no difficulty occurs in diagnosis;

though the possibility of aneurism, or tumour (hydatid), must be remembered.

In the early stage, any one of the subjective symptoms before mentioned may be the first complained of. In adults, numbness of the limbs, unsteady gait, persistent cramp, sciatica, neuralgia, constricting pain round the belly, especially excite suspicion of spinal disease. In children, so-called 'growing pains,' aversion to exertion, fearfulness of sudden movement, a desire to lie down, or to lean when standing, any peculiarity in walking, persistent 'stomach-ache' without derangement of the bowels—in a word, acting the malingerer from school, should never be disregarded. Pathognomonic of atlanto-axoid disease are stiff-neck, forward or sideway position of face, and posterior hemicrania (neuralgia of great occipital nerve).

In seeking for local pain in suspected cervical disease, it must be remembered that pressure over the fifth vertebra is distinctly painful, as compared with that over the other vertebræ, even in healthy people; and the vertebra prominens must not be mistaken for a boss. Both these mistakes the writer has seen made.

Treatment—(*a*) of caries of the spine; (*b*) of angular curvature.

(*a*) When the disease is active, as mostly indicated by pain, either early in the case or as a relapse, and if fever is present or paralysis threatens, absolute rest, giving immobility to the diseased bone, and relieving it from the superincumbent body-weight, is essential. This is best attained by the supine position on a hard mattress, and, where feasible, this plan should be adopted. If a child, he can be removed, mattress and all, into the open air, and as much change given as possible, but the same posture must be rigidly maintained. In this stage, blisters over the seat of pain are valuable; they quickly relieve the pain and, presumably, inflammation; two or three in succession must be used. Where there is local heat, with hyperæsthesia, leeches are preferable; setons used to be employed, but their annoyance is disproportionate to their benefit. When acute symptoms are not present, and especially with older patients who cannot be carried into the open air, or with those who are unable to obtain the necessary nursing, mechanical appliances are to be used; with these the patient can move about, and the general health improves thereby. Yet there is no appliance that can give the physiological rest that bed does, hence all appliances are useless whilst lying down; but to keep up the health and spirits requires more nursing attention than can usually be afforded, so mechanical support is employed in most cases. The instrument best adapted to the purpose is *Sayre's plaster-of-Paris jacket*. It is a rigid corset, moulded to the extended portion of the trunk, closely fitting, firmly grasping the pelvis, and reaching breast-high. It acts as an all-round support, and if applied during extension, it keeps off the weight of the upper part of the body from the disease, and holds the trunk straight, simply because any endeavour of the trunk again to 'telescope,' when the patient stands, thus necessitating a proportionate increase of breadth, is prevented by the rigid jacket, in which there is no room for the latter to take place.

Method of Application.—A tight-fitting, specially-woven, merino, sleeveless vest (but any merino vest will do if without buttons), and fastened by its two tags over the shoulders, is put on; its lower edge—which must reach the trochanter at least—is attached to a petticoat or towel wrapped round the legs; it is thus held down, and strained tightly to fit. Between it and the belly, and reaching down from the ensiform cartilage, is placed a flat bedroom towel, folded as when clean; this is the 'dinner-pad,' and it allows room for distension of the abdomen. The pad is not necessary in children who have prominent bellies, but is generally requisite in older patients; the towel is large enough for an adult, in others, a folded napkin is sufficient. If too large, the pad, when removed, leaves too much room, and the jacket may slip round and be useless. Small pads to protect the breasts are used in female patients. The patient is now suspended by two padded straps under the arms, and a collar which supports the chin and occiput, all being attached to a steel cross-bar, which can be raised or lowered by pulleys attached to a tripod or the ceiling. The patient is then gently raised on to tiptoe, or else right off the ground, the guide being pain. If in pain before, such extension only should be used as to make the patient easier; if not, then the extension may be carried out to the full, or short of producing any feeling of strain in the back. If pain be the guide as to the degree of extension, there is no risk of doing harm. Manifestly the degree to which extension may be carried depends upon the stage of the disease and the patient's weight.

All bosses or bony prominences, especially the anterior iliac spines, are now protected with pledgets of wool laid on *outside* the vest; if not so protected, sores from rubbing may result. The bandages are then applied. They are strips of the coarsest muslin (crinoline) 4½ yards long and 4 inches wide, previously prepared by being thickly dusted with *freshly-made* plaster of Paris before being rolled up. To moisten them they must be stood on end, two or three at a time, in a depth of water sufficient to cover them; when bubbles cease to rise they are ready to be applied. The first bandage is commenced round the hips, three-quarters of an inch below the anterior iliac spines, and holds in position the wool-pads that have been applied; after being firmly applied round the pelvis, it is carried obliquely upwards over the trunk, until it and the following bandages are equally distributed between the hips and chest. The lowest limit of the jacket is three-quarters of an inch below the iliac spines; the upper lies easily under the armpits, and should not make the patient high-shouldered. During the application an assistant keeps smoothing the bandages, and adapts them when requisite; turns are to be avoided as far as possible, nor should the bandages be drawn tightly, since they shrink on drying. The number of bandages varies from two to seven or eight. Children of ten years of age require three or four. With good plaster the jacket will have set before the patient is taken from the swing; but if the patient cannot remain the requisite time, he must be lifted down and laid on a mattress on his side until the jacket is set, and be then removed to bed, rolled up in a blanket. He should not, if possible, be allowed to walk until the following day. The dinner- and breast-pads are now drawn out; the woollen pledgets remain. If requisite, the jacket can be trimmed with shears or a knife; if it does not extend below the iliac spines it must be removed and a new one put on; a short jacket cannot be satisfactorily lengthened; when resting above the iliac spines it quickly rubs the skin into sores. Any jacket can be applied within five minutes.

With such a jacket the patient may go about; it will last six to twelve weeks, or longer, according to the progress of the disease and rapidity of growth. To remove it, it must be sawn up the middle with a tenon saw. The new jacket should be applied within twenty-four hours, the patient resting meanwhile. Some dispense with extension, but it ensures the jacket being applied when the chest is in the position of full inspiration, and relieves the diseased bones from downward pressure. There are two modifications in the application of the jacket.

Hammock method (Davy).—A piece of canvas wide enough just to meet round the patient, and twice his height, is suspended horizontally, hammock-fashion. In this the patient, wearing a merino vest, is laid face downwards, apertures being cut for the face and arms, so that the latter hang freely down through the canvas. Moistened plaster bandages are now applied round the body over the canvas, and the patient is then left till the jacket is set; the hammock is then taken down, and the ends cut away, top and bottom, to the level of the jacket; so the patient wears a layer of canvas in addition to his vest.

Recumbent method (Walker). — The same plaster bandages are used, but are moistened with gum and water; they are now cut in lengths exceeding the circumference of the patient's body by four inches; each length is laid flat on a table, one below the other, and overlapping for half its breadth; this is continued till a stratum of bandage equal in length to the vertical measurement of the trunk is completed. A second similar layer is now laid over this, strips of paper being placed at the edges to show the separation between the two layers. The patient is now laid on his back on the bandages, and the various strips are wrapped round him in order, and then left till the plaster has set.

The writer recommends and employs Sayre's original plan, as he fails to find any advantage in the modifications described. No rule can be laid down as to the length of time for the jacket treatment; it depends entirely upon the rate of repair. When all subjective signs have disappeared the after-treatment is begun: this mainly consists in substituting for the entire jacket one that is laced on, and so can be occasionally removed, whilst its not fitting so closely enables the cure to be tested.

Either the plaster jacket may be cut up and laced on, or, what is better, a felt jacket is put on. The 'poroplastic felt' usually employed is first roughly cut to the patient's figure, then steamed in an oven till soft, and then applied over a merino jacket; it sets when cold, and has then the requisite fastenings added. It is in this stage a good material to employ, but it cannot be so accurately applied as the plaster, and, being cut up, it gives less support; hence it is not advised in the earlier stages of the disease.

If there is a discharging lumbar sinus, a movable jacket, if any, must be used throughout. Windows cut in the plaster jacket do not answer.

In atlanto-axoid or occipito-atlantoid disease, as long as there are any subjective symptoms or dyspnœa, the supine position, with a small pillow under the nape, is the only safe one (Hilton). Sandbags on either side will keep the head from rotating. After probably two or three months the patient may get up, with a mechanical support. This may be either a leather or felt corset, bearing a stiff padded collar at the end of a steel rod, to support the head and prevent its rotating, or an adaptation of the plaster jacket. This consists of an ordinary Sayre's jacket, which forms the *point d'appui* of strips of plaster bandage, the centres of which are successively placed on the forehead, and the ends carried on each side over the ears, thence below the occiput, and finally across the scapulæ to beneath the axillæ, and there finished off; thus a rigid support to the head is provided (Furneaux Jordan).

In cervical disease below the axis, and in cervico-dorsal disease, the mechanical support may be the same, but Sayre's '*jury mast*' is better, as it permits rotation, and substitutes an elastic pull on the head for the stiff push up from below. It consists of a fishhook-shaped steel spring, which is attached below to a plaster jacket in the middle of the back, by being interwoven in the bandages as they are put on; the hooked part, passing up behind, arches over the head and carries a collar which supports the occiput and chin. The degree of extension exercised by the spring is regulated by straps to the collar. The upper part of the apparatus unscrews at the upper edge of the jacket, so as to be removed when the patient is in bed. A similar arrangement may be also attached to a movable (e.g. felt) jacket, though the plaster jacket is better for children.

Besides abscess, the special complication of spinal caries is paralysis. This, if due to pus pressure, must be treated by treating the abscess (*see* Psoas Abscess); but if due to inflammation of the cord or membrane, it is to be treated with iodide of potassium in 5-gr. doses, and the local use of counter-irritants; absolute rest being imposed.

The general medical treatment of caries is tonic. The writer prefers Syrupus ferri iodidi, or Ferri pot. tart., with Ol. morrhuæ in cold weather. Dialysed iron is not advised. The food and hygienic conditions must be the best obtainable.

(*b*) In treating angular curvature, it is presumed that all active disease has ceased, the deformity alone remaining. Extension and mechanical support are indicated—the former to expand the chest and relieve the compressed abdominal and thoracic viscera, the latter to maintain the gain by extension. In young subjects, who are still growing, the writer has seen the most marked improvement by the full use of the plaster jacket as above described; the boss, it is true, does not markedly diminish, but the total gain is great in a more erect posture and expanded chest. Where growth has ceased, the instruments mentioned under after-treatment above give enough support to make the patient useful in life; or one of the now old-fashioned 'spinals' (steel crutches arising from a leather and steel pelvic girdle) can be used; its only recommendation is that it lasts longer than felt. Of course many a 'hunchback' goes about without any mechanical aid whatever.

C. Hilton Golding-Bird.

CARIES OF THE TEETH.—As a result of original faulty development or of unfavourable subsequent conditions, the teeth are liable to a destructive process which consists in their decalcification and the disintegration of the organic matrix. It is, in the main, a chemical process, proceeding from without inwards; the theory which regards it as analogous to inflammatory softening of bones being untenable, because it occurs in dead equally with living teeth. During pregnancy, and after certain diseases, notably typhoid fever, the secretions of the mouth are in a state leading to wholesale destruction of the teeth, the destructive agents being probably acids generated by fermentations occurring in the mouth. Nooks and crannies, and the necks of teeth, where they are in close contact with the edge of the gums, are its chosen sites.

It therefore can best be combated by the most scrupulous cleanliness, by brushing the teeth after every meal, and by using alkaline washes copiously, a good formula being carbolic acid combined with a considerable excess of carbonate of soda or of liquor potassæ, and suitably diluted.

Bacteria are abundantly found in carious cavities, and penetrate the dentine to a considerable depth, but the precise share which they take is still *sub judice*; want of cleanliness offers them the most favourable opportunity for multiplication.

Of course all cavities as they arise should be at once filled; in health an annual careful inspection will obviate mischief proceeding to a disastrous extent before it is dealt with; but in cases where destruction is very rife, the teeth should be seen to twice, or even thrice a year, till the period of rapid decay has gone by. It may almost be said that by the time the patient has become aware of the decay the most favourable time for dealing with it by stopping has already gone by.

Left to itself, caries proceeds to the exposure and ultimate inflammation and death of the pulp, then to alveolar abscess. In very exposed positions it sometimes comes to a spontaneous cure, the softened tissue getting worn away and the surface attaining a high polish; this result may in suitable cases be artificially brought about.

Charles Tomes.

CAROTID ARTERIES, Aneurism of the.—*Common Carotid.*—Aneurism of this arterial trunk, particularly when of traumatic origin, may be regarded as a rare affection. The spontaneous variety occurs much less frequently than femoral and popliteal aneurisms of like origin, about as often as subclavian aneurism, and with greater frequency than aneurism of the axillary artery. It has been asserted that carotid aneurism is met with occasionally in young subjects; but in one only, of fifteen cases collected by Mr. R. W. Parker of spontaneous aneurism in persons under twenty years of age, was the common carotid the affected vessel. The proportion of male to female subjects is certainly much smaller in a large series of cases of carotid aneurism than in those of aneurism of any other large artery. Whilst, in all other forms of external aneurism taken together, one female is affected to eight males, in carotid aneurism the numbers of each sex, according to Crisp, are almost equal. Any portion of the common carotid as it courses in the neck may be the seat of aneurism; but the most frequent locality of the affection is at or near the bifurcation. The vessel on the right side is sometimes affected with well-marked though not very progressive dilatation just above its origin at the root of the neck. Aneurismal dilatation of the intra-thoracic portion of the left carotid must be very rare. The right side of the neck is much more frequently the seat of carotid aneurism than the left side.

Carotid aneurism in most instances presents the ordinary objective signs of aneurism of any other large artery situated near the surface of the body. The tumour pulsates very forcibly, and is more or less ovoid in form. It usually increases very slowly in size, and in some cases seems to remain stationary for a time, although it undergoes spontaneous cure very rarely, and ultimately, if left to itself, causes death by rupture, either externally or into the digestive or respiratory tract. The effects produced by the gradual expansion of the aneurismal sac are very varied and of a serious character, in consequence of pressure on important structures in the neck and of disturbance of the cerebral circulation. Most of these symptoms, however, are common to carotid aneurism and to any other deep-seated cervical tumour. Pressure on the laryngeal nerves or directly on the larynx or trachea may cause hoarseness, very troublesome cough, attacks of dyspnœa and spasm of the larynx. There is often more or less difficulty in deglutition, and sometimes—though this is a symptom more frequently met with in aneurism of the internal carotid—the pharynx is occupied by a prominent and distinctly pulsating tumour. The usual cerebral symptoms are headache, occasional giddiness and syncope, and loud subjective ringing or buzzing sounds. The patient complains at times of neuralgic pains on the corresponding side of the head and also on the surface of the neck. Pressure of the aneurism on the sympathetic may cause contraction of the pupil on the same side, and there is often some visual disturbance.

The diagnosis of carotid aneurism may be attended with great and, indeed, insuperable difficulty, especially in a case of pulsating tumour at the root of the neck, which might be due to aneurism of the subclavian, of the innominate, of the vertebral, or of the arch of the aorta. It is necessary in instances of this kind to study carefully the form, situation, and relations of the tumour, the direction in which its bruit is chiefly propagated, and the condition of the circulation in the head, the upper part of the neck, and the upper extremity on the corresponding side. No very positive results, however, can always be obtained by such investigation, since a swelling of like form, and pressure-effects of like nature and intensity to those of carotid aneurism, may, under certain conditions, exist with aneurism of either of the other arteries.

The morbid conditions by which an aneurism on any part of the carotid artery may be simulated are: glandular enlargement and suppuration; deep-seated suppuration of simple inflammatory origin; a new-growth, whether solid or cystic; a vascular tumour or an aneurismal varix; simple or pulsating bronchocele; and a pulsating malignant tumour. The chief points to be observed in establishing the diagnosis are, the shape of the swelling, its condition on proximal or distal compression of the carotid, its relation to and extent of connection with this vessel, the character of the pulsatile expansion, the intensity of the bruit, and the range of vertical movement of the swelling during deglutition.

The results of proximal ligature of the common carotid in the treatment of aneurism of this vessel have not been very satisfactory. Since 1805, when the operation was first performed by Sir A. Cooper, this plan of treatment has been repeatedly tried, and lengthy tables of such cases have been compiled by Pilz and Lefort. Of 47 cases collected by the latter surgeon 21 were fatal, whilst in 2 the operation was followed by relapse, and in some of the remaining cases reported as cured, the results, it is held, were doubtful. The most frequent causes of this tendency to failure of proximal ligature of the common carotid are inflammation of the sac, resulting in suppuration and hæmorrhage, serious cerebral symptoms, and hæmorrhage from the seat of ligature. Under the most favourable circumstances the operation is attended with much risk, and the records of the most successful cases show that recovery is seldom attained without the occurrence of some serious complication.

The results of distal ligature of the common carotid are also unfavourable. The operation, Lefort states, is almost always followed by diminution in the size of the aneurismal tumour, but, as with proximal ligature, there is much risk of subsequent suppuration and rupture of the sac, and also of cerebral mischief. Most of the few recorded cases, however, of distal ligature for carotid aneurism are probably very doubtful, as decided aneurismal dilatation, affecting only the root of the carotid, is not often met with, and its diagnosis must be attended with much difficulty.

The old method of opening the sac and applying a double ligature to the affected artery has been applied with success in cases of traumatic aneurism of the carotid by the second Hey, by Syme, and, more recently, by Frothingham, of Michigan. In 1880 Mr. Henry Morris, in some comments on a case of spontaneous aneurism of the external carotid, reported to the Royal Medical and Chirurgical Society, suggested that it would be best in carotid aneurisms near the bifurcation of the common trunk to ligature simultaneously the common carotid and such branches of the external carotid (facial, superior thyroid, and lingual) as are easily accessible.

Notwithstanding the difficulties in applying and keeping up pressure in the neck, compression, both digital and instrumental, below the tumour, has hitherto been attended with much success in some few cases of carotid aneurism. Mr. Holmes, who has collected seven cases, in two only of which this treatment failed, holds 'that there are forms of carotid aneurism easily curable by compression, and that compression of the carotid artery, though difficult and painful at first, may often be rendered successful by perseverance both on the part of the surgeon and the patient.' It has been proved, also, that a carotid aneurism at the root of the neck may be cured by distal pressure.

In a case of small carotid aneurism, if indirect compression fail after a fair trial, it may be found advisable to try direct compression before any cutting operation be performed. Of this method, however, very little is known beyond a successful case recorded in 1867 by Ciniselli, of Cremona.

Arterio-venous aneurism of the carotid artery and jugular vein has been met with in some few instances. This condition, which almost always, if not always, presents the form of aneurismal varix, is commonly the result of a sword injury. The symptoms are usually well-marked, and resemble those of a similar lesion to other large vessels, but are seldom of such severity as to justify any operative treatment.

External Carotid.—Aneurism of this vessel is usually of the traumatic variety, and implicates one or more of the branches. It presents no special characters. There must necessarily be some difficulty in determining the origin of an aneurismal tumour in this region; but the diagnosis of an aneurism of the external from one of the internal carotid may be assisted by observations of the state of the temporal pulse, and probably, also—as in a case recorded by Mr. Christopher Heath—by the existence of unilateral atrophy of the tongue.

Internal Carotid.— Aneurism of the extra-cranial portion of this vessel, like aneurism of the common carotid, may give rise to cerebral disturbances, but its most marked symptom is a pulsating tumour in the pharynx.

The treatment in cases of aneurism of the secondary carotid vessels should consist, at first, in a careful and persevering attempt at proximal compression, and subsequently, if this fail, in ligature of the common carotid; or, in the case of the external carotid, near its origin, ligature of some of the branches of this vessel together with that of the main trunk, as advised by Mr. Morris. W. JOHNSON SMITH.

CAROTID ARTERY, The Common. *Course.* — From the upper part of the sterno-clavicular articulations both arteries ascend on the side of the trachea and œsophagus as high as the upper border of the thyroid cartilage. The left artery comes from the aortic arch close to the left of the innominate; the right results from the division of the innominate. The lower part of the left artery is surgically unimportant. The vessels are practically alike anatomically in the neck.

Whatever the position of the head, a line from the sterno-clavicular articulation to the lobule of the ear marks the course, as high as the upper border of the thyroid cartilage, where the artery ends. For descriptive purposes, it is divided into two parts by the crossing of the anterior belly of the omo-hyoid muscle. This muscle crosses on a level with the cricoid cartilage.

The common carotid artery *above* the omo-hyoid lies in what is known as the superior carotid triangle, bounded by the omo-hyoid below, the digastric and stylohyoid above, and the sterno-mastoid behind. The superficial coverings are similar to those over the lower part of the artery. The sterno-mastoid overlaps it; the descendens noni is usually on the sheath, but sometimes within; and the superior thyroid vein, with frequently the lingual and facial veins, crosses its upper end. *Behind* are the vertebræ covered by the longus colli and the rectus capitis anticus major, also the sympathetic cord; *externally*, the internal jugular vein and vagus nerve; *internally*, the larynx and pharynx, covered over by the inferior constrictor muscle. The superior thyroid artery passes down on the inner side of the vessel.

LIGATION. — Place the patient on his back, with the shoulders raised, and the face turned to the opposite side. Make an incision, three inches long, from the level of the upper border of the thyroid cartilage downwards in the guiding line, or *vice versâ*; cut through the cutaneous structures, raise the deep fascia carefully—on a director is the best plan—and open it. Now flex the head slightly, to relax the sterno-mastoid, so that it can be pulled outwards. According to where it is wished to apply the ligature, the omo-hyoid muscle is pulled down or not; it is best to do so, and to tie the artery opposite the crico-thyroid membrane. Pick up and incise the common sheath on the inner side, avoiding the veins crossing its upper end. Open the immediate sheath, and pass the needle from the vein, avoiding the internal jugular vein externally, the pneumogastric behind, the superior thyroid artery internally, and the descendens noni nerve in front.

Below the omo-hyoid muscle the coverings are—the skin; superficial fascia having in it, the platysma, the anterior jugular vein, and the descending branch of the transverse cervical nerve; the deep fascia. The sterno-mastoid muscle overlaps it; the sterno-hyoid and sterno-thyroid muscles cover it and cross it; the descendens noni nerve lies on these muscles.

Behind are the transverse processes of the seventh, sixth, and fifth cervical vertebræ, covered by the longus colli muscle. *Internally*, the trachea. *Externally*, the internal jugular vein, and the pneumogastric nerve. The internal jugular vein on both sides tends to the right, hence it departs from the right artery below, but overlaps the left artery. The vessel consequently is more easily reached on the right side.

LIGATION. — Make an incision in the guiding line from the sterno-clavicular articulation to the level of the cricoid cartilage. Cut through the cutaneous coverings described, so as to expose the inner border of the sterno-mastoid; now bend the head slightly forwards, and pull—outwards the sterno-mastoid, inwards the sterno-hyoid and sterno-thyroid muscles, upwards the omo-hyoid and the structures associated with it. Open the common vascular sheath, pull outwards the internal jugular vein and the pneumogastric nerve, and inwards the descendens noni; open the immediate sheath, and pass the needle from the vein inwards, keeping close to the vessel.

JAMES CANTLIE.

CAROTID ARTERY, The External. *Course.* — From the bifurcation of the common carotid at the upper border of the thyroid cartilage, the artery passes upwards to just behind the neck of the condyle of the lower jaw, where it divides.

The coverings are:—skin; superficial fascia, with the great auricular nerve and the external jugular vein; the platysma and the deep fascia. When the deep fascia is opened, it is seen that part of the artery below is in the superior carotid triangle, and that part of the artery above is in the parotid gland; the separation being marked by the crossing of the posterior belly of the digastric and the stylo-hyoid muscles over the artery. In the superior carotid triangle, the artery is crossed by the hypoglossal nerve, and the facial, lingual, and superior thyroid veins; in the parotid gland, the facial nerve and the external jugular vein are superficial to it. Beneath, i.e. internal to the artery, is the pharynx below, with the superior laryngeal nerve crossing to reach the larynx; whilst higher up, between the internal and external carotid arteries are the styloid process, the stylo-pharyngeus muscle, the glosso-pharyngeal nerve, and a piece of the parotid gland. Externally is the internal jugular vein; the internal carotid is seen on the outer side for almost one inch of its course, when it disappears underneath.

Ligation.—Place the patient as for the common carotid operation. Make an incision from just behind the angle of the jaw, downwards along the line of the artery, to just below the upper border of the thyroid cartilage. Divide the cutaneous structures, advisedly using a director for the deep fascia. Draw aside the veins crossing the artery if possible; if not, tie each in two places, and cut between. Pull the digastric and stylo-hyoid muscles and the hypoglossal nerve upwards, the sterno-mastoid outwards. Open the sheath, and pass the needle from without—i.e. from between the artery and the internal jugular vein, with the internal carotid artery externally. The ligature is usually passed immediately above the origin of the superior thyroid artery. James Cantlie.

CAROTID ARTERY, The External, Wounds of branches of the.—The violence of all bleeding from the throat and neck, the suddenness of its occurrence, and the rapidity with which it proves fatal, render the question of the treatment of the following accidents of grave interest to the surgeon:—

1. Punctured wounds about the angle of the jaw or through the mouth. 2. Hæmorrhage after injury to the tonsils. 3. Hæmorrhage from cancer, or from the sloughing of the throat in scarlet fever or diphtheria. 4. Secondary hæmorrhage after wounds or operations.

In some of these cases the careful and accurate adjustment of pressure has occasionally succeeded, while in others cold, astringents, or the actual cautery has been employed with success. In one or two instances the ingenuity of the surgeon has suggested a remedy, as in a case of secondary hæmorrhage after operation for cleft palate, where the bleeding was permanently arrested by a wooden plug in the posterior palatine canal. However successful these palliative measures may occasionally prove, there will remain a certain proportion of cases in which their use is impracticable, or has been employed in vain. If there were a probability of finding the bleeding vessel by enlarging the wound this might be done; but in many instances such an operation would be anatomically impossible. In these circumstances, ligature of the main vessel in continuity has to be resorted to, as the only practicable means of stopping the bleeding.

The common carotid artery has been the vessel usually selected. The writer, however, considers that the external carotid is the better artery to tie, and has fully described the reason for this preference in a paper published in the *Medico-Chirurgical Transactions*, lxi.

Ligature of the common carotid for hæmorrhage is an operation of extreme danger to life, having a death-rate of more than 50 per cent., a large proportion of the fatal cases either dying from brain-symptoms, or a recurrence of hæmorrhage from the original wound. The brain-symptoms are the result of cutting off the blood-supply through the internal carotid, while the recurrence of hæmorrhage from the wound is due to the freedom of the anastomosing circulation. If hæmorrhage continues after deligation of the common trunk, the blood finds its way to the wound from one of the following sources: 1. As a regurgitant stream down the internal carotid. 2. By the communications of the superior with the inferior thyroid. 3. By branches anastomosing across the middle line. By ligature of the external carotid between the thyroid and lingual branches all risk of brain-symptoms is obviated, while the chance of recurrent hæmorrhage is diminished, inasmuch as the communications by the internal carotid and superior thyroid are cut off. The fact of the free anastomoses between the thyroids was markedly illustrated in a case of Guthrie's, in which the external carotid artery was wounded. Here the common carotid artery was tied, but it failed to arrest the bleeding. A ligature was then placed upon the external carotid above the wound, but blood still poured out. The external carotid was then again tied just above the superior thyroid, and the bleeding at once ceased.

An objection might naturally be raised to placing a ligature on the external rather than on the common carotid, on the ground that the surgeon assumes that it is a branch of the former that is wounded, and that, should the bleeding vessel prove to be the internal carotid, an operation worse than useless would have been performed. The answer to this is, that in cases where the common carotid artery had been tied for hæmorrhage, and in which post-mortem examinations were subsequently obtained, it was extremely rarely found that the original wound had been one of the internal carotid—a circumstance to be explained by the fact that a wound of so important a vessel will generally prove fatal in a few minutes, thus affording no opportunity for any surgical interference. In the great majority of cases the bleeding vessel proved to have been one of the numerous branches of the external carotid, and could have been controlled by ligature of that vessel.

The same incision that is employed for ligature of the common carotid above the omohyoid would expose the external branch, which can be traced up from the bifurcation.

Harrison Cripps.

CARPAL BONES, Dislocation of the.

Transverse or Midcarpal Dislocation of the hand, as a result of which the second row of carpal bones is separated from the first, only occurs as the effect of great violence, and is very rare. Malgaigne mentions two cases—one, *forwards* and compound, caused by machinery; the other (Maisonneuve's) *backwards*, caused by a fall from a height. In this case the hand was shortened and the fingers flexed; there was a prominence behind below the level of the styloid processes; in front another, with a depression below, *vis-à-vis le pli transversal du poignet.* Reduction has been found difficult or impossible during life, and easy after death. Both these cases died from other injuries. More recently Richmond has described a case in this country of midcarpal dislocation of the hand forwards. A man was drawn up by the strap of a machine nine or ten feet, and fell on his hand. The first row of carpal bones, with the radius and ulna, projected behind, and the second row, with the metacarpal bones, formed a prominence at the base of the hand in front.

Dislocation of any bone of the carpus alone is a rare accident, and generally the result of extreme violence. Of the first row there are instances of separate dislocation of the scaphoid, semilunar, and pisiform bones.

Dislocation of the Pisiform Bone occasionally occurs as the result of forcible action of the flexor carpi ulnaris. Gras, Fergusson, and Erichsen have recorded cases produced in the act of lifting heavy weights. The bone is to be felt displaced upwards to the extent of about an inch. The treatment is to flex the hand on the forearm and the forearm on the arm, in order to relax the flexor muscles; to retain the hand in position by means of a curved dorsal splint, and to fix the bone by a pad and strapping.

Dislocation of the Semilunar occurs more frequently than any other bone of the first row, and is often compound. It may be dislocated *forwards* or *backwards.* The forward dislocation is caused by a fall from a height with the hand extended, and the bone has on several occasions been driven completely through the skin in front of the wrist. This occurred in both hands of one case, the bones from which are preserved in the museum of St. George's Hospital. The effect of its displacement forward beneath the tendons may be to cause flexion of the middle and ring fingers, as in a case recorded by Cameron. Dislocation backward is caused by a fall on the back of the hand. In an instance observed by Erichsen, the bone projected behind, and could be reduced by pressure, but started up again upon flexion of the hand on the wrist.

The treatment, if reduction be effected, will be to retain the palm of the hand on a splint, with a pad over the bone, for two or three weeks. When the dislocation is compound, it is probably advisable to remove the bone at once; if simple and irreducible, it may be excised antiseptically. But without these precautions, considering the relation of the bone to the wrist and great carpal joints, as well as to the tendon-sheaths, an operation is scarcely to be recommended. A compound case operated upon, and reported during the present year by Buchanan, was followed by amputation of the hand; but excision was not performed till the fifth day, and not till after cellulitis had commenced.

Dislocation of the Scaphoid.—Astley Cooper relates two cases of this injury: one a compound case caused by machinery, the other a simple dislocation backwards, together with a portion of the radius obliquely fractured into the joint, caused by a fall on the back of the hand. Malgaigne is inclined to throw doubt on the latter case.

Dislocation of the Os Magnum.—Dislocation of the head of the os magnum backwards appears to be the most frequent of the isolated displacements of the carpal bones. It is much more common in women than in men, and Malgaigne classes it as pathological rather than traumatic. It has been caused by falls on the back of the hand, and by muscular contraction during the throes of labour. A rounded projection is seen, situated above and opposite to the base of the metacarpal bone of the middle finger, and a depression close to the base of this bone. In a case related by Cooper, the forefinger was abducted and could not be made to approach the middle until after the dislocation had been reduced. Reduction is effected by pulling on the first and second fingers, and at the same time pressing upon the displaced bone. There is great tendency to reluxation on strongly flexing the hand, to prevent which, a palmar splint, with a pad over the bone behind, should be worn for two or three weeks.

R. Clement Lucas.

CARPUS, Dislocation of the. *See* Wrist-joint, Dislocation of the.

CARR'S SPLINT. for Colles' fracture, consists of a strip of wood about 2 inches wide and 11 inches long, having an irregularly convex surface which is adapted to the shape of the lower end of the radius, and has an obliquely-placed cross-piece, 4 inches long and 1 inch in diameter, attached to its distal end. The splint is applied to the anterior aspect of the forearm, so that the cross-bar lies opposite the metacarpo-phalangeal joints when the hand is adducted. A light dorsal splint may also be applied, but it is not necessary.

Bilton Pollard.

CARTE'S COMPRESSOR. *See* Tourniquets.

CARTILAGE, Articular. *See* Articular Cartilage.

CARTILAGES, Aural. *See* Ear, External.

CASTRATION.—Preparatory to the operation, the pubes and scrotum should be carefully shaved and thoroughly cleansed. For the latter purpose, carbolic lotion, 5 p.c., may be used; but as the thin skin of this region may be irritated by this lotion, corrosive sublimate solution 1–500, or the solution of sulphurous acid B.P., may be substituted for it. Before commencing the operation, a careful examination for hernia should be made, and if present, its contents should be reduced and kept up by an assistant's finger placed over the abdominal ring. The patient being fully anæsthetised, the surgeon should grasp the back of the testicle in his left hand, so as to stretch its coverings over the front, and should then make an incision from the external abdominal ring to the bottom of the scrotum, and quickly cut through all the layers of fascia and muscle until the outer surface of the tunica vaginalis is reached. With a few touches of the knife, the testicle, in its serous covering, is severed from the scrotal tissues; the union between the two is most firm at the lower end of the scrotum. At this stage it is well to place pressure-forceps on all bleeding vessels in the scrotum, as oftentimes the hæmorrhage from this source is profuse. The surgeon should then carefully examine the cord to determine at what part to sever it, and he should proceed to transfix it, about half an inch above this point, with an aneurism needle armed with a double thread; and should tie it tightly in two halves, and then cut it across. The best material to use for this ligature is silk which has been soaked for some time in carbolic lotion, 5 per cent., or stout chromic catgut.

When the stump of the cord has been examined and found to be quite dry, and the surgeon is satisfied that his ligatures are secure, their ends should be cut off short, and the cord will retract into the inguinal canal. The forceps should then be taken off the scrotal vessels one by one, and those that are bleeding should be twisted or tied with fine catgut. After cleansing the wound with corrosive sublimate solution 1–1,000, a drainage-tube should be laid along it and brought out at its lower end, and the edges of the skin approximated by carbolised silk sutures. Owing to the contraction of the dartos, the skin is inverted, and this, unless corrected, delays the perfect healing of the wound. It may be overcome by making a very close continuous suture of the skin with very fine catgut in addition to the deep interrupted sutures. The whole operation may be conducted aseptically, and dressed accordingly. A very good form of dressing is to sprinkle finely-powdered iodoform over the line of incision, and to apply a thick mass of iodoform cotton-wool over the scrotum and pubes—the penis being brought out through it—and fasten it in position with a firm and carefully applied bandage. This dressing need not be disturbed for two days, when, if the tube be dry, it should be removed, the dressing renewed, and left undisturbed for several days, unless pyrexia, or pain, or some other disturbance, necessitate the examination of the wound.

Certain other details may be mentioned. If the testicle to be excised be adherent to the skin, that portion of the scrotal coverings should be removed with the organ by means of two elliptical incisions. Where the surgeon is in any doubt as to the nature of the tumour he is operating for, he should open the tunica vaginalis and explore it—even cutting into the testicle itself if necessary—before detaching it from the scrotum. Owing to the extreme difficulty of diagnosing some cases of hæmatocele, it is a good rule to tap every scrotal tumour before excising it, or, still better, to cut into the tunica vaginalis before detaching it from the scrotum. When there is a large collection of fluid in the tunica vaginalis, it is an advantage to tap the sac before the operation, or to puncture it before dissecting it away. When the case is complicated with inguinal hernia on the same side, the surgeon should at the same time attempt the radical cure of this affection, by dissecting up the sac, stitching it together at the ring, removing the part beyond, and drawing together the pillars of the ring, if that aperture be large. When the cord is thickened high up, it may be necessary to slit up, on a director, the aponeurosis of the external oblique muscle where it covers the inguinal canal, and to ligature the cord close to the internal ring.

There are several other ways of treating the cord, but if the ligatures are tied tightly, the above is the best. Should hæmorrhage occur from the cord—primary or secondary—the inguinal canal must be laid open and the bleeding vessel tied. Where the gland to be removed lies in the groin, the parts covering it must be divided with a vertical incision, and the organ turned out of its bed, and the cord tied as above. As this condition is very often combined with hernia, great care must be taken to seek and, if found, to close any peritoneal prolongation or pouch.

On a few occasions a testicle, retained in the iliac fossa, has been removed on account of cancerous disease. This may be done either by laparotomy, the incision being made in the median line, or by an incision, similar to that for ligature of the external iliac artery, the parts being divided down to the subperitoneal fat, and the peritoneum stripped off the face of the tumour.

A. Pearce Gould.

CATARACT is opacity of the crystalline lens. *See* Crystalline Lens. It occurs in many forms, partial and complete, and is met with at all periods of life, but is more frequent in the old and in the young than in the middle-aged.

Causes and Pathology.—The lens is, by development, a cuticular structure, and is formed of successive layers of fibres derived from the epithelial cells which line its capsule. As in the cuticle, the older layers are firmer, drier, and more closely compacted than the younger; but, unlike what happens in the cuticle, they are not cast off at a free surface, but are constantly surrounded and driven inwards towards the centre by those more newly formed. Unless morbid processes intervene, the addition of fresh fibres at the periphery, and the progressive hardening of the older ones towards the centre, go on throughout the whole period of life, and as a consequence the volume of the lens continually increases, at the rate of about 1·5 cub. mm. each year. At the same time the refractive power undergoes a gradual change, and the fibres, colourless in early life, assume a yellowish tinge, but there is no loss of transparency. The following figures indicate the average weight, volume, and diameter of the lens at the ages of twenty-five and sixty-five respectively; they were obtained by the examination of more than twenty lenses in each decade of life. Weight, 174 and 240 milligrammes; volume, 163 and 225 cub. millimetres; transverse diameter 8·67 and 9·65 millimetres. The average specific gravity is about 1,070, and is not essentially different at different ages (*Trans. Ophth. Soc.* vol. iii. p. 79). The lens, having no direct vascular relations, depends for its nutrient supply on fluid secreted by the ciliary processes, which enters it chiefly, if not entirely, at its periphery, i.e. at the zone corresponding with the apices of the processes and Petit's canal. The causes of cataract are all those conditions which interfere with this normal growth and nutrition.

Classified according to cause, cataract is of three chief kinds:—(*a*) *Primary*, i.e. arising independently of discoverable disease in other parts of the eye. This group includes the great majority of the cases of cataract other than traumatic, which call for surgical treatment, namely all cases of ordinary senile cataract, and most of the varieties met with in infancy and childhood. (*b*) *Traumatic*, i.e. due to mechanical injury of the lens. (*c*) *Secondary*, i.e. resulting from obvious disease in other parts of the eye.

(*a*) *Primary Cataract.*—The nutrition of the lens is sometimes arrested during fœtal life. When this happens, the last-formed fibres, or sometimes the whole of those already formed, shrivel and degenerate and lose their transparency. If, after a while, the normal process is re-established, layers of healthy fibres are laid down upon the damaged ones, and growth continues. A congenital cataract is the result, the lens presenting on examination after birth either an opaque nucleus surrounded by transparent layers, or simply a layer of opaque fibres enclosing a transparent nucleus, and itself enclosed by a transparent cortex. Or the opacity may be spindle-shaped, extending from the anterior to the posterior pole, and associated in some instances with the nuclear or lamellar forms above described. Such spindle-shaped opacities date probably from a very early period in the development of the lens; the opaque substance being adherent to the capsule, is stretched out more and more as the new fibres are laid down, and forms a permanent obstacle to their union in the axial line. Or, again, if the shock to the nutrition of the lens is extreme, a restitution of the process of growth may never take place, and at birth the lens may be opaque throughout, or may be represented merely by a small mass of degenerated fibres, enclosed within a shrivelled capsule. The causes of these intra-uterine disasters are not accurately known; they certainly include mechanical and nervous shocks to the mother, and probably some constitutional diseases productive of lowered vitality in the fœtus. Malformation of the lens at birth is sometimes a part of a general malformation of the eyeball.

Disturbance of the nutrition of the lens seems sometimes to occur rather suddenly during infancy and childhood, and to leave a lamellar opacity similar in kind to that already described as arising *in utero*. It is probable, however, that some cataracts which appear to be acquired in infancy are really of intra-uterine origin, the original disturbance damaging the fibres, then in process of formation, to an extent which is not sufficient to render them opaque, but which leaves them liable to further damage by comparatively slight causes, mechanical or other, after birth. A case is on record in which an infant's lenses, previously examined with the ophthalmoscope and found transparent, became opaque immediately after a convulsive seizure. There is, however, no reason to deny that nutritive disturbances may cause a lamellar opacity during extra-uterine growth in the same way as at an earlier stage. The amount of transparent matter between the opaque lamella and the capsule should be some guide as to the time which has elapsed since the initial disturbance. Children presenting lamellar or other varieties of primary cataract are very generally delicate in appearance and of nervous temperament. A history of convulsions in infancy is frequently forthcoming on inquiry, though this connection is not an invariable one. Signs of rickets are present in many cases, and in a very large majority the teeth show peculiar defects consisting in an abruptly limited deficiency or absence of enamel on the upper part of the tooth. The teeth affected are the first molars, canines, and incisors, of the permanent set. As the crystalline lens and the teeth are, alike, epithelial structures and develop at the same period, it is reasonable to suppose that the defects in question are due to a common cause affecting the nutrition of both.

During the middle period of life, primary cataract arises much less frequently than at either extreme, and when it does occur it is in most cases due to one specific cause—diabetes. In persons suffering from diabetes, cataract may occur at any age; it has been met with so early as the twelfth year. The amount of sugar in the urine is usually large, and the nutrition of the patient greatly impaired. When this is not the case, the patient is usually advanced in years. Sugar is present in these cases in the fluids of the eye, and has many times been found in the lens itself; but the precise way in which it induces the changes in the lens-fibres is still uncertain. The volume of the lens appears to be increased by excessive imbibition of fluid, a large portion of which enters, not in the normal direction, but by diffusion through the anterior and posterior capsule.

The third or last period of life, during which senile degeneration of many kinds is common, yields a large majority of all cases of primary cataract. The whitening and thinning of the hair, and the shrivelling of the skin, common in advanced life, find their physiological analogue in an increasing tendency to shrinkage and sclerosis of the lens-fibres; and this sclerosis, if it pass beyond a certain point, involves separation and disintegration of the fibres. Beyond the age of seventy, some slight opacification near to the equator of the lens is rather the rule than the exception. The writer's investigations on the growth of the crystalline lens (*loc. cit.*), besides establishing the fact of a continuous enlargement throughout life, have shown that previous to the formation of actual opacity in the lens there is usually a diminution in the rate of growth. The advancing sclerosis and shrinkage cause a separation of the fibre-layers just where the capsule and subjacent fibres are most affected by the traction of the suspensory ligament, viz. at the equator, and this separation is usually the first step in the formation of senile cataract. By it a clear line of demarcation is established between the nucleus, or sclerosed portion, and the cortex, or non-sclerosed portion; the spaces caused by the separation of the layers fill with fluid; abnormal diffusion-processes ensue, which lead, more or less rapidly, to further splitting of the layers and breaking up of the individual fibres into a molecular mass, until the whole substance of the lens is more or less opacified, and sometimes, in the last stage, fatty and calcareous degenerations occur. Simultaneously with these retrograde changes, a rapid and abnormal production of new cells usually takes place in the capsular epithelium, due probably to a lessening of the intra-capsular pressure by which the cell-proliferation is ordinarily held in check.

Though the tissue-changes which constitute cataract are thus accurately known, the causes which determine their occurrence—earlier in some persons, later in others—are still uncertain. Albuminuria, and atheroma of the carotids have been supposed to play an important part in the causation of senile cataract, but careful inquiry shows this conjecture to have small foundation. The essential change is a failure of nutrition in the epithelial cells and fibres of the lens; it is likely that vascular degeneration in the region from which the nutrition proceeds, is the underlying cause. In a certain sense, senile cataract is hardly to be considered a morbid condition, but rather one of senile decay occurring prematurely, and one to which all eyes would come did their owners live long enough. The peculiar condition of the lens known as black cataract will be described later in discussing the symptoms of the various forms.

(*b*) *Traumatic Cataract* is due, in the great majority of cases, to perforating wounds of the globe which involve the lens-capsule. Contusions without perforation occasionally cause rupture of the capsule and thus lead to cataract; and in rare cases the lens-substance opacifies as the immediate result of an injury which neither perforates the tunics nor causes any break of continuity in the capsule. Injuries which involve damage to the uveal tract may, of course, impair the nutrition of the lens to such an extent as to lead, in course of time, to its degeneration; in such cases the cataract should be classed rather as secondary than as traumatic. When the capsule is wounded, the fibres in the immediate neighbourhood of the opening rapidly imbibe fluid from the aqueous or vitreous chamber, swell up and thereby become opaque, and finally disintegrate. This occurs more or less rapidly according to the size of the wound and the age of the person. In the young eye absorption of the entire lens-substance may take place. It is not very unusual, however, for the disturbance caused by a small wound to remain for a long time limited to the part injured; for example, a minute fragment of metal, or other foreign body, becoming embedded in the lens, may leave only a small localised opacity, connected with the capsular wound by a fine opaque line, marking the path along which it travelled. In such cases the opening in the capsule doubtless closes at once and completely. Such closure is promoted by adhesion of the iris at the point of injury, but may occur quite independently of it. The most frequent causes of traumatic cataract are punctures produced by scissors, forks, needles, awls, thorns, sharp fragments of metal, &c.: when wounds of larger size involve the lens, the injury is frequently so extensive as to cause total destruction of the eye.

(*c*) *Secondary Cataract.*—Many diseases of the eye, and especially those which involve the uveal tract, and which impair the secretory function of the ciliary processes, are apt secondarily to induce degeneration of the lens. Thus cataract is common as a late result of cyclitis, irido-cyclitis, choroiditis, retinitis pigmentosa, absolute glaucoma, retinal detachment, and intra-ocular tumour. In many of these conditions the lens acquires adhesions with false membranes and vascular tissues, and imbibes fluids in directions in which, normally, no fluid permeates the capsule. A special tendency to proliferation of the capsular epithelium, due probably to this morbid nutrient supply, is characteristic of many kinds of secondary cataract. The clinical importance of secondary cataract is usually not great, for at the stage in which it occurs the eye is often blind, or nearly so, from the original disease, but there is one variety in which this is not the case, and which, therefore, deserves special notice: anterior polar cataract. In some forms of secondary cataract—namely, in those which depend upon choroidal disease—the opacity begins at the posterior pole of the lens.

Anterior Polar Cataract may arise either before or after birth; in either case the cause is of the same kind—namely, contact of the lens-capsule in the pupillary area with an inflamed cornea, or with products of inflammation in the anterior chamber. Morbid fluid, and in some cases pus-cells, traverse the exposed portion of the capsule and excite proliferation and disturbance in the subjacent epithelium and fibres. The capsule is eroded and thinned, and often somewhat elevated by the projecting mass of débris beneath it, forming a small prominent opacity, known as a pyramidal cataract; or the opacity may take the form of a circular group of dots corresponding with the margin of the pupil. The process is essentially the same, whether the resulting opacity is punctiform, flake-like, or pyramidal. A perforating ulcer, often the result of purulent ophthalmia immediately after birth, is the usual cause of anterior polar cataract, but perforation is not necessary to its production. During fœtal life, in which no anterior chamber exists, any inflammatory affection of the cornea, probably, may suffice to affect the capsular epithelium, and, as a matter of fact, in many cases of congenital anterior polar cataract no trace of a corneal cicatrix is discoverable. This form of cataract usually remains unaltered throughout life.

In an advanced stage secondary cataracts are apt to undergo calcification, especially if they are in abnormal and close relation with vascular membranes. The chalky deposit is found first in the layer of new tissue formed by the proliferation of the capsular epithelium, and in the pseudo-epithelium which forms within the posterior capsule. Later it invades the entire lens-substance, progressing from periphery to centre. Calcareous deposits of smaller size are found in primary senile cataracts in an advanced stage, in the form of thin films of strongly refracting granules near to the capsule. Total calcification of the lens is a matter of months, if not of years, for the intra-ocular fluid is poor in inorganic constituents, and the interchange of fluids is extremely slow in the degenerating lens. A mass of true bone may be formed in the position normally occupied by the lens, and may assume the contour of the lens, the process being an ossification of morbid tissue which has taken the place of the lens, and been moulded into its shape by pathological formations surrounding it; but ossification of the lens-substance itself, while still enclosed in its unbroken capsule, never occurs.

SYMPTOMS AND DIAGNOSIS OF CATARACT. The *subjective symptoms* consist only of the visual troubles which naturally arise from a want of transparency in the lens. As a means of diagnosis they are no longer of much moment, for since the introduction of the ophthalmoscope the presence of cataract in any stage is determined by objective methods only; but it is important, none the less, to know the kind of complaints which are made by persons suffering from cataract in various stages, and in all cases in which operative measures have to be considered, a careful testing of the subjective condition is necessary in order to ascertain the presence or absence of retinal or other complications which would detract from the result of the operation or render it useless.

The extent to which vision is affected depends upon the amount of the opacity and upon its relation to the pupillary area. A few small opaque striæ at the margin of the lens, such as usually constitute the beginning of senile cataract, and, indeed, may remain unaltered for many years, are not incompatible with perfectly sharp vision. In like manner the small opaque white dot seated in the centre of the pupil, known as anterior polar cataract, causes little or no impairment of vision, though the eyes in which it is found often have defective sight by reason of the corneal cicatrices, which commonly accompany it and are due to the same original cause. Apart from these two forms, cataract always causes more or less impairment of vision. Simultaneously with its commencement there is often a change of refraction in the lens in the direction of myopia. *See* REFRACTION, Errors of. The patient states that the convex glasses which used to clear distant objects no longer give any assistance, indeed that he sees more clearly without them. Hypermetropia, formerly present, has disappeared. In many cases eyes previously emmetropic become myopic. At the same time, or very soon afterwards, the acuity of vision begins to fail, and continues to do so from month to month; reading has to be given up; after a while the patient can no longer safely walk alone; and finally only the power of discerning light from darkness remains. Unless cataract be complicated with disease of other parts of the eye perception of light is never lost, and the patient can indicate with considerable accuracy the position and movements of a luminous object, such as a candle, held before his face. In the earlier stages of the disease bright light—direct sunlight, for example—usually distresses the patient and increases his difficulty in seeing. This is due partly to the dazzling which is produced when the opaque particles in the lens are strongly illuminated by rays of light impinging directly upon them—a phenomenon easily realised when one sees how much more obscure a dusty window-pane becomes where it catches the sunlight than where it is shaded by the window-frame—and partly to contraction of the pupil. The latter is of course most detrimental when the opacity is seated chiefly in the central region of the lens. In such cases vision is often distinctly better towards evening, or when the patient turns his back to the window and shades his eyes with his hand, by reason of the dilatation of the pupil which occurs under those circumstances.

In young children who are the subjects of lamellar cataract, the impairment of vision is sometimes so moderate in degree that it attracts no attention until, with the first attempts at schooling, it appears that the child is unable to learn his letters without great difficulty. In cases where the opaque lamina is very thin, the child may even learn to read and write without much difficulty, and go through a large part of his school life without coming under medical examination with regard to his sight. From his habit of bringing his book very near to his eyes such a child is often supposed to be myopic rather than the subject of cataract, and, as a fact, myopia is not infrequently present in addition to the lental opacity. Though the periphery of the lens is clear in these cases, the clear zone usually lies quite outside the area of the pupil, so that it is *through* the cataract, and not round it, that the child sees. In the denser forms of congenital and juvenile cataract the impairment of vision may be quite equal to that caused by the densest senile cataract, and it is often the essential cause of another peculiar symptom—viz. nystagmus, or continuous oscillations of the eyeballs.

The *objective symptoms* of cataract are the visible changes in the lens. In an advanced stage cataract usually manifests itself readily to ordinary daylight inspection, the pupil presenting, instead of its normal blackness, a grey, yellowish-grey, brownish-grey, or even solid white, appearance, which tells at once of opacity in the region of the lens. Simple inspection is, however, insufficient for a safe diagnosis. Those who venture by its means alone to pronounce an opinion as to the presence or absence of cataract will inevitably sometimes fall into serious error. The normal sclerosis of the lens-fibres increases their power of reflecting light, and at sixty or seventy years of age the normal lens, instead of being completely invisible, as in early life, gives to the pupil a distinctly greyish look, indistinguishable in some cases, on ordinary inspection, from commencing cataract. Under certain circumstances, notably in glaucoma, this reflex is still further increased, and sometimes to such an extent that a lens which is in reality quite transparent may simulate a cataract almost ready for extraction. This resemblance has often led to unfortunate mistakes; persons suffering from glaucoma have been told that their failure of vision was due to cataract, and have, on this account, postponed the question of an operation until their eyesight was nearly, if not entirely, extinguished—that is to say, until the glaucoma had passed into an incurable stage. Hence the importance of a precise investigation of every case.

The condition of the crystalline lens is investigated by two methods: firstly, by *focal illumination*, a method which strongly illuminates any portions of the lens-substance which are opaque, and, when the opacities are few and small as compared with the transparent matter, causes them to stand out against the latter as against a dark background; secondly, by the help of the *ophthalmoscope*. If any considerable portion of the lens remains transparent, the light from the mirror passes through it to the fundus of the eye, and this, being situated in the focus of the lens, is more strongly illuminated than the lens itself, and affords a bright background, against which opacities in the latter stand out as dark markings. When the opacity is general it, of course, intercepts the light of the mirror, and prevents the illumination of the fundus; the opaque parts then appear illuminated as in the focal method.

For focal illumination the patient is placed at a distance of about two feet from a lamp, and in such a position that the light falls upon his face somewhat from one side, rather than directly from in front. The observer holds a lens of two or three inches focus between his finger and thumb, as he would hold a burning glass, and placing it in a line between the lamp and the eye, and at about its own focal distance from the latter, focusses the light upon the pupil. Any opacities lying near to the anterior surface of the lens, and within the area of the pupil, are by this means at once brought into view, and by varying the position of the patient's eye in relation to the light, and looking into the pupil in different directions, a large part of the lens may be brought under examination. To examine the posterior pole of the lens, the eye must be directed nearly towards the lamp, so that the light enters the pupil nearly in the perpendicular direction, and the observer must look into it as nearly as possible in the same direction. The peripheral parts of the lens can only be completely examined after dilatation of the pupil by atropine, or some other mydriatic.

In examining with the ophthalmoscope, the observer looks obliquely into the eye from different points of view rather than from directly in front. By this means the extreme contraction of the pupil which ensues when the patient is allowed to look towards the mirror is avoided, and as much as possible of the periphery of the lens is brought under examination. The light employed should be of only moderate intensity, or the fainter forms of opacity are likely to be overlooked. The eye of the observer should be focussed for the patient's lens rather than for the fundus, and to this end it is useful to place behind the mirror a convex lens of sixteen or twenty inches focus, and to approach to a point somewhat within this distance of the eye; or a convex lens may be held between the mirror and the patient's eye, or even placed close in front of the latter in the ordinary trial spectacle-frame. The depth at which an opacity lies in the substance of the lens is estimated most readily by the focal method, but it may also be determined by means of the ophthalmoscope. An opacity occupying the centre of the anterior capsule is seen as a dark, opaque spot in the centre of the illuminated pupil, and, since it is practically in the plane of the iris, does not move from this central position, however obliquely the observer may look at it. A similar opacity at the centre of the posterior capsule, on the other hand, is only to be seen in the centre of the pupil when the observer's eye stands exactly in line with the axis of the lens. If from this position he moves slightly to either side, the opacity appears to move towards the corresponding side of the pupil. The rate of this apparent movement, or, in other words, the readiness with which the opacity disappears behind the margin of the pupil, is a guide to its depth behind the plane of the iris. On the same principle, opacities which lie behind the lens, namely, in the vitreous body, are distinguished from lental opacities by the greater rapidity of their apparent movements. Vitreous opacities, moreover, often show more or less independent movement of their own, called forth by movements of the eye, but continuing after these have ceased.

Opacity of the cornea occasionally simulates cataract to a superficial observer; the distinction is made at once by focal illumination. A filmy opacity in the anterior stratum of the vitreous—that is, in actual contact with the posterior lens-capsule—is at times hardly distinguishable from an opacity within the capsule, and, indeed, the distinction is not very important, for cataract appearing in that form is usually secondary to changes in the vitreous fluid. A dense opacity in the region of the vitreous humour, such as is produced by glioma (*see* OPTIC NERVE and RETINA), and by those infiltrations of the vitreous which resemble glioma (*see* VITREOUS), sometimes presents an appearance which may be mistaken for cataract unless a careful focal examination be made with especial regard to the depth of the opaque body behind the iris. Again, small masses of pigment remaining adherent to the anterior lens-capsule after the subsidence of an iritis, are sometimes not to be distinguished with the ophthalmoscope alone from opacities beneath the capsule, or in the anterior layers of the lens-substance; their position, however, will usually suggest an iritic origin, and a careful focal examination will set the matter at rest. There are cases, however, in which an inflammatory exudation in the anterior chamber not only leaves opaque deposits on the outer surface of the capsule, but, by osmosis through it, sets up changes in the capsular epithelium, which lead to punctiform opacity within it.

Since the introduction of the ophthalmoscope the so-called catoptric test, by which the transparency of the lens is investigated by observing the images of a candle reflected from its anterior and posterior surfaces, has almost passed out of use; but it may still be sometimes employed with advantage, notably when the presence of a black cataract—a variety which neither focal illumination nor the ophthalmoscope can reveal with certainty—is suspected.

The earliest objective sign of *senile cataract* is usually the presence of a few linear or wedge-shaped opacities, beginning apparently near to the equator of the lens, and pointing towards its axis. They are at first to be seen only by looking very obliquely into the eye, and may be quite beyond the reach of inspection until the pupil is dilated with atropine. They indicate a splitting up of the fibre-layers at the junction of the sclerosed portion or nucleus, and the non-sclerosed portion or cortex, and may be found, on careful examination, to embrace the margin of the nucleus, passing inwards both over its anterior and posterior surfaces. Prior to the appearance of actual opacity visible under focal illumination, the ophthalmoscope will sometimes detect the presence of radiating streaks or lines, which shift their position or disappear as the direction of the light is varied; these indicate the formation of minute interstices filled with clear fluid, and are usually near precursors of actual opacity. In the course of months or years the marginal striæ increase in number and size, and invade the area of the pupil. They coalesce to form sector-shaped and flake-like patches of opacity, and they extend towards the capsule. Gradually the whole pupillary area becomes opaque, and the red glare of the fundus is no longer visible with the ophthalmoscope. For a while longer the laminar structure of the lens may be indicated by glistening sectors or radiating lines, and then these also disappear, and the opacity assumes a more uniform, greyish, or yellowish-white look, and involves the whole of the cortical substance quite up to the capsule. At this stage the cataract is, from the surgical point of view, *mature.* The special signs by which maturity is estimated will be described farther on.

The appearances which cataracts present in a still later stage correspond with the further degeneration of the opaque cortex. More or less shrinking usually occurs, which gives to the capsule a shrivelled look; spots and patches of a denser white make their appearance, and the bulk of the cataract is noticeably diminished. Less commonly the capsule remains distended by fluid imbibed from without, and the disintegrated fibres break down into a semi-fluid pulp. Occasionally the liquefaction of the cortex is so complete that the nucleus, which always retains its consistency, floats freely about in it, when the head is bent forwards falling against the anterior capsule so as to become visible, disappearing when the head is thrown back. This condition is known as 'Morgagnian' cataract. The brilliant white spots and patches which make their appearance on the surface of over-mature cataracts are due to changes in the capsular epithelium, and constitute what is called capsular cataract. The opacity differs from that of the lens-substance, not only in being denser and whiter, but in being devoid of stellate marking, and in being limited to an area not exceeding that of the moderately dilated pupil. A final change occasionally to be witnessed in over-mature cataract is the spontaneous loosening of the lens from its attachments. In consequence, probably, of the shrinking of the lens, the suspensory ligament gives way at some part of the circle, and the shrivelled lens is drawn towards the opposite side, leaving a clear space, through which, with the help of a cataract-glass, the patient may enjoy useful vision, or the lens may fall back into the vitreous chamber and leave the pupil entirely free. This spontaneous cure of the blindness is a rare event, and occurs for the most part only after the cataract has been complete for many years, and in persons whose nutrition is greatly impaired.

The foregoing description of the development of the opacity in senile cataract is applicable to very many cases, but not to all. In some the opacity, instead of advancing from the periphery towards the pupillary area, makes its appearance in the central part first, and thence gradually extends outwards. This does not necessarily imply that the degeneration begins actually in the nucleus; in some cases, certainly, it is the cortical layers immediately overlying the surface of the nucleus which suffer first, and the cataract is really cortical throughout, as in the form already described. But in others the morbid process actually begins in the nucleus, and the cortical layers suffer later, the rate of progress being for the most part extremely slow. This is a true nuclear cataract. It appears, in some respects, to stand midway between the ordinary cortical cataract of the old, and the general soft cataract of the young. The opacity has a diffuse, cloudy look, and is devoid of the radiate marks which are common in cortical cataract, though there is sometimes in the cortex a Y-shaped line of opacity, causing a well-marked tripartite division. In colour it is milky or yellowish. In the nucleus the opacity may develop quickly, but its invasion of the cortex is very slow, and the patient must wait through a long period of partial blindness before the cataract is sufficiently ripe for extraction. These are the cases in which vision is decidedly improved by a moderate dilatation of the pupil, either as the result of shading the eyes, or by the use of atropine.

Diabetic Cataract presents no specially distinctive appearances. Its characters vary, like those of other forms, with the age of the subjects. Thus, in young people, the whole lens—there being no hardened nucleus—becomes opaque throughout, while in old people the cortex and nucleus are differentiated, as in ordinary senile cataract. Both lenses are commonly affected together, or very nearly together. In all cases of double cataract in young or middle-aged adults the presence of diabetes should be suspected.

Black Cataract is a term applied to a peculiar and rare condition of the lens met with in the second half of life. To ordinary inspection the pupil appears black; focal illumination fails to reveal any decided opacity; but no reflex from the fundus is obtainable with the ophthalmoscope. Under the catoptric test the image of the candle which should be produced by reflection from the posterior surface of the lens is wanting, the lens is of a deep brown colour throughout, and though it presents none of the ordinary signs of opacity is practically impenetrable by light. Such lenses are in reality not cataractous at all, but owe their opacity to a great excess of the brown coloration which is present to some extent in all healthy lenses in later life. It has been asserted that the coloration is due to an infiltration of the lens-substance with hæmatin; but lately a careful spectroscopic examination has proved that it is not derived directly from any of the blood-pigments; the colouring matter belongs to the same class of pigments as melanin, and presents analogies with the colouring matters of hair and feathers; it is, in short, a cuticular pigment, a further point of analogy between the lens and the skin. (*Trans. Ophth. Soc.*, vol. ii. p. 10.)

Traumatic Cataract varies greatly in its course and symptoms according to the nature and extent of the injury and the age of the patient. Under focal illumination the opacity can generally be traced to a wound in the lens-capsule. From this it spreads, sometimes in the course of a few hours, sometimes much less rapidly, to the whole of the lens-substance, which swells considerably as it becomes opaque. In the soft lens of childhood the spread of the opacity and the swelling are much more rapid than in the hard lens of advanced life. A wound of some size in the anterior capsule of a child's lens is followed, in a few hours, by the escape of a considerable mass of grey lens-matter into the anterior chamber, and not only the extruded portion but the whole of the remainder, with the exception of a few films adhering closely to the capsule, may in the course of a few weeks undergo spontaneous solution and removal, so that a black pupil is restored. A smaller wound will lead more slowly to the development of a complete cataract, and the process of absorption may come to a standstill, so that surgical interference is required before disintegration and removal of the opaque matter occur. Very small wounds, as has been already stated, sometimes close at once, and cause nothing more than a small limited opacity in their immediate neighbourhood. Small fragments of metal or other foreign substance entering the lens may lead rapidly to total cataract, or may for a considerable time remain the centre of a small opacity which spreads no further. Or, passing completely through the lens from front to back, they may leave only an opaque line in their path. When the anterior and posterior capsule are both wounded, the opacity spreads more from the anterior than from the posterior wound, the vitreous humour taking less effect upon the exposed fibres than the aqueous. A fragment of iron, or other metal liable to undergo chemical changes, may in course of time cause discoloration of the opaque lens-substance in which it is embedded; such discoloration should therefore excite suspicion of a foreign body being present. Other things being equal, a wound of a senile lens is a more serious injury than a wound of a young lens; for in advanced life, the lens, being of large size, is in closer relations with the surrounding structures, and is therefore, when it swells, more likely to cause difficulties with the iris and ciliary processes than the smaller lens of a child or young adult. In the uncommon cases of traumatic cataract in which the capsule is not ruptured, the opacity generally makes its appearance first at the anterior or posterior cortex, and advances much less rapidly than when the capsule is opened.

Lamellar Cataract is less easily made out by ordinary inspection of the eye than many other forms. With an undilated pupil it is often quite invisible until focal illumination or the ophthalmoscope is used, Looking straight into the eye with the ophthalmoscope, the observer notes that the reflex from the fundus is imperfect, but the cause of the dimness is not revealed until he looks obliquely behind one or other border of the pupil. Then the periphery of the lens is seen to be quite clear and to stand out sharply against the central clouded area. The opacity appears to become more dense towards its outer margin, where it is limited by a well-defined dark outline; this however, is more apparent than real, and is due to the fact that at the margin the opaque lamina presents itself edgeways, while in the central area it lies perpendicular to the line of view. The apparent increase of density towards the margin of the opacity distinguishes the lamellar from the solid nuclear form of cataract. In the latter the density is of course greatest in the axis of the lens, where the largest amount of opaque substance lies. Under focal illumination, with dilated pupil, a lamellar cataract presents the appearance of a bright semi-transparent filmy vesicle or shell, lying without visible attachments in the midst of a transparent medium. The amount of opaque matter varies from an almost invisible film in some cases to an almost solid-looking mass in others. The initial disturbance of the fibres is very probably in most cases an intra-uterine event, but a decided and sometimes sudden increase of the opacity is not infrequent during infancy or early childhood. Beyond this time of life an extension of the opacity is the exception, rather than the rule. From the margin of the opaque area radiating stripes or lines may sometimes be seen, extending outwards into the clear portion, and an increase of these at any time would indicate the probability of a general opacification; as a rule they are stationary. An inner shell of opacity may sometimes be seen within the outer one, the two being quite concentric and separated from each other by a layer of transparent substance; an instance of three distinct layers of opacity is on record. In nearly all cases lamellar cataract affects both eyes. The total nuclear, membranous, and other congenital varieties of cataract do not require detailed description; the appearances which they present may be best interpreted by considering the manner in which the fœtal lens is built up, and the effects which would result from disturbance of its growth at various periods.

Secondary Cataract may usually be recognised as such without difficulty. In many cases signs of a bygone iritis or iridocyclitis are present, and if the opacity is not sufficient to completely hide the fundus, deeper-seated disease of the uveal tract may be discoverable. The loss of vision is generally greater than can be accounted for by the lental opacity only, and in very many cases amounts to total blindness; the character of the opacity itself is sometimes a sufficient evidence of its being the result of other mischief in the eye. Thus a stellate opacity seated in the posterior cortex of the lens is an almost certain sign of choroidal disease of one kind or another. It is frequently met with in the later stages of retinitis pigmentosa. It is to be distinguished from a rarer form of posterior polar cataract which is congenital, and which probably depends upon an abnormality in the fœtal hyaloid artery. This latter presents the appearance of a solid glistening plaque, and has not the diffuse and radiate character of the choroidal cataract. The radiate opacity is internal to the capsule and follows the anatomical arrangement of the fibres; the plaque is probably external, and owes its glistening look to its being lined, as it were, by the capsule. Anterior polar cataract—a small central opacity immediately beneath and involving the anterior capsule—is, as already stated, an evidence of bygone corneal suppuration. A dense irregular patch may sometimes be seen occupying the centre of the anterior capsule in what looks like an ordinary senile cataract; it tells of morbid secretions in the anterior chamber. Again, the more pronounced degenerative changes to which secondary cataracts are liable often give them a brilliant white or yellow appearance which declares at once that the lental disease is not the primary one.

Maturity.—From the surgical point of view, this is one of the most important questions involved in the examination of a cataract. A cataract is said to be mature when the adhesion of the cortex to the capsule is so far destroyed that the whole of the lens-substance can escape readily when the capsule is opened—in other words, when the cataract will leave its envelope as a ripe nut leaves its shell. To this end the whole cortex, and especially the layers in contact with the capsule, must be involved in the degeneration. Generally speaking, a cataract is not mature until the opacity has come close up to the capsule. In order to estimate maturity, the observer illuminates the eye by the focal method, causing the pencil of light to fall upon it obliquely from one side. If there be a layer of transparent matter between the opaque fibres and the capsule, the edge of the pupil nearest to the light will cast a shadow of crescent form into the substance of the lens, while if the opacity be immediately beneath the capsule, no such shadow will be cast upon it. In the second place he throws light upon the lens with the ophthalmoscope, when, if it be mature, no red glare from the fundus will be obtainable. The rule then is that a mature cataract receives no shadow into its substance on focal illumination, and permits no illumination of the fundus. But the rule is not absolute. There are cataracts which fulfil both these requirements, and yet are immature, and there are mature cataracts which fulfil neither. Thus, in some instances, the soft opaque cortical substance is entirely wanting, or very nearly so, the whole lens consisting apparently of a large brownish-yellow nucleus, which, although sufficiently clouded to destroy useful vision, will still allow some illumination of the fundus, and receive a shadow on focal examination. Such cataracts grow darker in colour with age, but do not become truly opaque. They will often separate readily from the capsule, and are therefore, in a surgical sense, mature. Again there is a form in which the opacity appears first in the nucleus, and invades the cortex very slowly; ultimately a thin subcapsular layer becomes opaque, and then the cataract is ripe for removal, even though the iris may still cast a shadow into it. On the other hand, despite the ordinary signs of maturity, a cataract is not fully ripe if, under focal examination, its surface shows well-marked glittering sectors. These indicate that some thin flakes still remain transparent, and, so long as this is so, a complete separation of the cataract from the capsule cannot be relied on. The glittering appearance is usually not of long duration; the sectors soon break down and then the cataract is mature. (Förster.)

A thorough examination of the condition of the lens can only be made after the pupil has been dilated with atropine, or homatropine, the latter being sometimes preferable because of its more transient action; but, in using either of these drugs in elderly people, it is well to remember that, where any tendency to glaucoma exists, dilatation of the pupil is apt to intensify it. The tension of the eye should therefore be carefully ascertained beforehand. Priestley Smith.

CATARACT, Treatment of.—*Therapeutic Treatment* is powerless to remove an opacity of the lens, and very rarely has any decided effect in delaying its progress. Still, the possibility of doing some good by general treatment should not be entirely lost sight of. Slight opacities of the lens have been known to clear up, and in very many cases they remain stationary for long periods of time; it is, therefore, always right in the early stages of the progressive forms of cataract to inquire as to the habits of life and the constitutional condition of the patient, and to correct any faults, as far as may be possible, in the hope of lessening the tendency to further degenerative changes. Among other alleged remedies electricity has been put forward as a cure for cataract, but no satisfactory evidence of its utility has been given. It is very probable that some of the reported cures by this and other therapeutic measures have been due to the clearing up of cloudy conditions of the vitreous.

Palliative Treatment, which aims not at removing the opacity, but at diminishing its detrimental effect upon the sight, is very useful in certain forms and stages of cataract. Thus, tinted glasses to moderate the light, atropine to enlarge the pupil, iridectomy to uncover a transparent portion of the lens when the opacity is chiefly central, sometimes give much help. Their special application will be discussed in connection with the various forms of cataract. Apart from these palliative measures, the only treatment which is available is an operation for the removal of the opaque lens.

Operative Treatment.—Broadly speaking the operations now employed for the removal of cataract are of three kinds: 1. Those which by admitting the aqueous humour freely into the substance of the lens promote its solution in, and spontaneous removal by, the fluids of the eye. 2. Those by which it is removed piecemeal through a small opening in the wall of the eye. 3. Those by which it is removed more or less unbroken and entire through an opening of larger size. A fourth method, distinct in principle from the foregoing, was formerly much employed, but has now fallen into almost complete disuse—the operation known as couching or reclination, by which the opaque lens was dislocated backwards into the vitreous humour, so as to leave the area of the pupil free. The choice between these several methods in any given case is determined by the consistency of the cataract. From the operative point of view cataracts may be classed as hard or soft. A *soft* cataract is one which is either pulpy throughout, or will become so after the aqueous has been freely admitted into its substance, and which, therefore, can be removed through a small opening. A *hard* cataract is one which, having a firm nucleus, cannot be rendered pulpy throughout, and which therefore demands a much larger opening for its removal from the eye. Whether a cataract is hard or soft depends, not upon the nature of the morbid process, but upon the natural consistency of the healthy lens at the corresponding time of life. With few exceptions, in early life all cataracts are soft, in advanced life all are hard; there is no sharp line separating the one class from the other, the transition is gradual, like the process of sclerosis by which the hardened nucleus is formed. For practical purposes, the age of thirty or thereabouts may be taken as the point that separates the cataract which is soft throughout, from the one in which a firm nucleus must be expected. It is not often that a doubt on the matter arises, for, except as the result of injury, cataract at this time of life is rare.

Before taking each of the chief varieties of cataract in turn, and pointing out how it should be dealt with, it will be well to deal generally with the question of *the use of anæsthetics in cataract operations.* Until lately it has been the custom of many operators to use ether, chloroform, or some other general anæsthetic, in most operations for cataract; others have employed them only for children and for nervous adults, in whom the necessary self-control could not be expected. In addition to the avoidance of pain, anæsthesia confers the advantage of passivity of the eye and eyelids; but it carries with it the drawbacks of nausea and constitutional upset for a time after the operation, and the chance of vomiting, which, in certain cases, may greatly imperil the eye. In operations which do not include a large wound, the risk from the latter cause is slight and need hardly be considered, and the question of an anæsthetic must depend on the amount of pain likely to be given and the steadiness of the patient. In needle operations, which involve only the cornea and lens, the pain is slight; in iridectomy it is more severe. In iridectomy for artificial pupil, in which a wound of the lens would be a serious disaster, the need for passivity is at its greatest. When a large wound is to be made, as in extraction of senile cataract, vomiting involves great risk, and on this account, as well as that the patient may be able to assist the operator by voluntarily directing his eyes in the required direction, some surgeons dispense with anæsthetics almost entirely in the removal of senile cataract. The matter has remained one for individual choice and experience. The writer, having found that the administration of fifteen or twenty grains of chloral-hydrate by the mouth about twenty minutes before ether-inhalation much diminishes the liability to sickness, has used this mode of anæsthesia largely with good results.

Koller's discovery in September, 1884, of the power of cocaine to induce local anæsthesia in the eye, has, in the course of a few months, changed the practice with regard to anæsthetics in ophthalmic operations, all over the world. A few instillations of a four per cent. solution of hydrochlorate of cocaine, render the whole of the conjunctiva and cornea sufficiently anæsthetic for operations which involve these structures only; the iris may be rendered subnormally sensitive by a further instillation after the anterior chamber has been opened; and, with care and a warning to the patient not to flinch at the moment when the iris is seized, operations involving this membrane also may usually be satisfactorily carried out. Hence, nearly all the operative measures which are required in treating cataract may now be undertaken with the help of local anæsthesia only. In cases in which severe congestion and inflammation of the eye are present—as, for example, in some cases of traumatic cataract—the effect of cocaine in lessening sensibility is very slight.

LAMELLAR AND NUCLEAR CATARACT IN YOUNG PEOPLE.—In these forms the opacity is usually non-progressive, and the marginal zone of the lens remains permanently clear. In a few cases of the lamellar variety, vision is sufficiently good for all ordinary purposes, and it is best not to interfere in any way; usually we have to decide between the formation of an artificial pupil by iridectomy, and the removal of the lens by a needle operation. If, after wide dilatation of the pupil by atropine, and the correction of any refractive error, vision still remains very insufficient in both eyes, and if the eye appears to be sound as regards the condition of the retina and in other ways, the removal of the lens is indicated; but if, on the other hand, vision is found under these circumstances to be fairly good, it is better simply to uncover the margin of the lens at one part of the circle by an iridectomy. (For a description of the operation, *see* IRIDECTOMY.) The latter proceeding has several advantages. It is a safe operation, and is very quickly recovered from; it permits of useful vision without the use of spectacles; it spares the accommodative function of the eye; it does not preclude, but rather facilitates, the subsequent removal of the lens, if this should prove necessary. On the other hand, it must be allowed that in a light-coloured iris an artificial pupil is disfiguring, but the wearing of cataract-glasses is hardly less so. Some surgeons remove the lens from one eye, and at the same time iridectomise the other. This practice is decidedly objectionable, for although the aphakial eye may be aided with a glass, the two eyes will not work well together; the patient probably soon lays aside the glass, and learns to depend almost entirely upon the eye which has the artificial pupil, thus proving that an iridectomy in both would have served his purpose better. The position of the *artificial pupil* must correspond with a clear part of the lens-margin, and must be determined by careful examination beforehand with the ophthalmoscope. If possible it should be downwards and inwards.

In cases of lamellar cataract both eyes usually require operation. There is no objection to operating for artificial pupil on both at one time. The only accident which can easily happen, in making an artificial pupil in the cases now under consideration, is wounding the lens. Should it occur, the case must be dealt with as one of ordinary traumatic cataract in a young subject.

Two other methods of making an artificial pupil are occasionally employed—iridodesis and iridotomy. *Iridodesis*, or the entanglement of the iris in the cornea, was recommended by the late Mr. Critchett, but has been abandoned because it may lead to sympathetic ophthalmitis. *Iridotomy*, which signifies the cutting, merely—not the *cutting out*—of iris, is sometimes practised, but is dangerous for zonular cataract; though, as will be seen later, iridotomy is a most valuable operation for opening up the pupil when the lens is absent. *See* below and Iris.

Those cases of lamellar and nuclear cataract, for which an operation for artificial pupil is obviously unsuited, or in which it proves insufficient, must be treated by the needle operation (discision), followed, if necessary, by linear extraction, with or without the help of suction. These methods will be described in connection with the treatment of complete soft cataract—the form of the disease in which they are chiefly employed.

Complete Soft Cataract.—In infancy and childhood an opaque lens may usually be got rid of by one or more simple needle-operations. By this proceeding the anterior capsule is lacerated, and the fibre-layers are more or less broken up and exposed to the action of the aqueous humour. Any portions not previously opaque become so, and the whole lens-substance swells, softens, and gradually dissolves in the fluid which macerates it. The younger the patient, the more rapidly does the process of disintegration go on, and the less danger is there of inflammatory complications on the part of the iris. This is a reason for early operation in cases of congenital cataract. A stronger reason still lies in the fact, that the absence of visual impressions, in very early life, appears to act unfavourably on the development of the brain-centres which control the movements of the eyes. Children blind from birth, or blinded soon after birth, as, for instance, by purulent ophthalmia, frequently present the symptom known as nystagmus—a continual oscillation of the eyes indicative of disordered action in the cerebral centres for ocular movements. A needle operation, if it is required, may properly be undertaken in the third month after birth, before its results are likely to be interfered with by the troubles of dentition. An earlier interference than this is not desirable, for at birth the aqueous humour is scanty, and the anterior chamber extremely shallow.

Needle Operation (Discision) and Solution.—The pupil must be thoroughly under the influence of atropine. The instruments required are the speculum, the fixing forceps, and a cataract-needle. Some operators prefer, in the absence of an anæsthetic, to fix the lids and globe with the fingers rather than with instruments. The extremity of the needle is flattened and has two cutting edges; in the shaft it is cylindrical and slightly tapered, so that it completely fills the puncture which it makes, and prevents escape of the aqueous. A stop or shoulder on the shaft serves as a guide to the depth to which it enters the eye, and gives it additional strength. The speculum being in place and the globe fixed, the point of the needle is pushed rather obliquely through the cornea in its outer and lower quadrant, at a point about midway between the centre and the margin, and carried to the centre of the pupil; by a few gentle to-and-fro movements it is then made to divide the centre of the capsule with crossed cuts, and to break up the anterior layers of the lens. The needle is then carefully withdrawn, its flattened point coming out in the same plane as it went in. The iris must not be touched with the needle; the aperture made in the capsule must be smaller than the pupil; the lens must not be forcibly or deeply cut into; the movement of the needle must not be such as to drag upon the cornea, but must be made in lever fashion around the corneal puncture as a fixed point. After the operation, the pupil is kept dilated to the utmost by applications of atropine at intervals of not more than three hours; a fold of linen, dipped in cold or iced water, is kept lying across the lids for forty-eight hours, or longer if there is any reaction, and later the eyes are covered with a shade. Exposure to strong light is to be strictly avoided. In very young children any application over the eyelids sometimes causes much fretting, and does more harm than good; the eyes must then be allowed to remain uncovered, and the room darkened.

The result of the operation is that the lens-matter immediately adjacent to the wound in the capsule becomes opaque, if it was not so already, swells, protrudes, more or less, into the anterior chamber, and ultimately shrinks and disappears, the bulk of the lens being thereby reduced. In a few cases a single operation leads to complete solution and removal of the lens. More commonly the needling has to be repeated two, or three, or more, times, at intervals of several weeks. In the later operations, the needle may be used rather more freely than at first, for the lens is smaller, and a sudden and dangerous swelling of its substance is less likely to occur. During the whole period of the treatment, the eye is to be kept thoroughly under atropine and no fresh needling must be undertaken so long as the slightest sign of irritation remains over from the last. In the final stage there sometimes remains an opaque membrane upon which the process of solution takes no further effect. If this cannot be readily divided by the single needle, it is safer to employ two than to drag upon the ciliary processes in the effort to tear it through. One needle is passed through the inner half of the cornea and through the centre of the membrane, the other through the outer half of the cornea and to the same spot in the membrane; then, by approximating the handles, the points are separated, and an aperture is torn in the membrane without any dragging on its ciliary attachments (Bowman). Instead of repeating the needling when the process of solution appears to be at a standstill, it sometimes answers well merely to evacuate the anterior chamber by a small opening in the cornea; the fluid thus drawn off is highly charged with the débris of the lens; it is replaced by a fresh aqueous secretion, and solution begins again.

The needle operation, when properly performed and followed by careful after-treatment, is a safe procedure. The complications which we have to fear are iritis and even irido-cyclitis from irritation of the vascular structures in the neighbourhood of the lens, and increase of tension—secondary glaucoma—caused by the pressure of the swollen lens against these parts and consequent compression of the filtration channels at the angle of the anterior chamber. Slight congestion in the ciliary region without pain is not serious; but if the congestion be considerable, and the colour of the iris altered, a severe iritis is imminent, and must be promptly met by the application of two or three leeches to the temple or lower eyelid, very free instillation of atropine, persistent use of iced compresses, and, if the bowels be inactive, a purge. If the inflammatory symptoms persist, or if the eye become hard, either with or without pain and congestion, relief must be given immediately by removal of the swollen lens-matter by linear extraction or the suction method described below. The tendency to glaucomatous complication increases as the size of the lens increases; it has, therefore, a direct relation to the age of the patient. The needle operation alone is suited chiefly to the complete cataracts of children. In young adults, in whom the process of solution goes on more slowly, and to whom time is of more value, it is usually supplemented by linear extraction or suction. It is not well suited, even in children, to fluid cataracts, nor to those which have tough and thickened capsules.

Linear Extraction.—This operation affects the removal of the softened lens piecemeal through a small straight incision in the cornea. It is applicable to soft cataracts, for which the needle operation proves insufficient; to fluid and other completely softened cataracts, without previous needling; to traumatic cataracts below the age of twenty-five, when the swollen lens-matter sets up inflammation or excess of tension; to lamellar, nuclear, and other partial forms of cataract, after they have been made complete by previous needling. The instruments required are the speculum and fixing-forceps, a keratome, a cystotome, and a curette. Under the same conditions as before with regard to dilatation of the pupil, separation of the lids, and fixation of the globe, the keratome is passed through the cornea at a point 2 or 3 mm. within its outer margin, and carried onwards parallel with the iris until an incision from 4 to 6 mm. in length is effected. It is then slowly withdrawn. If the lens-capsule be not already opened the cystotome is introduced, care being taken not to entangle its point in the iris, and the capsule is lacerated as freely as the size of the pupil will allow; it is then withdrawn with the same precautions as before. Instead of using the cystotome some surgeons open the capsule with the point of the keratome at the moment of completing the incision. If the iris prolapse through the wound, the extruded portion is taken up with iris-forceps and cut off as in an ordinary iridectomy. The curette is then gently pressed upon the outer lip of the wound, so as to make it gape a little, and at the same time slight pressure is made upon the globe with the fixing forceps. A considerable portion, if not the whole, of the lens-substance is by this means evacuated, and the pupil at once assumes a more or less black appearance. In order to effect the removal of any fragments which may remain, the speculum is now removed, the eyelids closed, and a few light rotatory stroking movements made over the cornea by means of a finger on the upper eyelid. Time is given for the anterior chamber to refill with aqueous. On re-opening the wound by pressure with the curette, a further clearance of the pupil will then take place. Pains and time must be devoted to removing in this way all particles of lens-matter which can be got away, but it is not advisable to put instruments of any kind into the anterior chamber for this purpose. It is better to leave some lens-matter in the eye than to irritate it by violence. Fragments which remain behind are usually absorbed. The after-treatment is the same as in the needle operation.

Suction.—This operation differs from the foregoing in the manner of obtaining the escape of the lens-matter. The incision need not be quite so large as in the former case. The instrument through which the soft lens-matter is drawn out of the eye is a smooth round-ended metal canula, mounted either on a small syringe worked on the principle of an aspirator by the hand of the operator (Bowman), or on an india-rubber tube with a mouthpiece, which is held and aspirated with the lips (Teale). The canula is passed into the chamber with its aperture towards the cornea, and gently dipped into the semifluid lens-matter. By very gentle suction this is gradually drawn up into the tube, as much being removed as possible. The nozzle of the instrument must be brought as little as possible into contact with the iris, and must not be passed behind it in search of fragments. The operation gives, in many cases, excellent results; it is followed, however, every now and then by suppuration and loss of the eye. Delicacy of manipulation and absolute purity of the suction instrument are essential to the avoidance of these disasters.

Hard Cataract.—In the earlier stages of senile cataract palliative measures sometimes give much help. For outdoor use 'globular' spectacles, combining the power which gives the best distant vision with a blue or neutral tint, to lessen the uncomfortable glare caused by bright light, should be ordered. If the opacity in the pupillary area is considerable, while the lens-margin is comparatively clear, a moderate dilatation of the pupil by atropine, such as may be attained by the use of a single drop of a very weak solution once a day, or on alternate days, is likely to give help. A tenth of a grain of the sulphate of atropia to an ounce of distilled water is quite strong enough for such a purpose. The possibility of inducing glaucoma by wide and prolonged dilatation of the pupil must not be forgotten. During the earlier stages of the disease the opportunity should be taken of examining and carefully noting the ophthalmoscopic appearance of the fundus; for there may be changes of importance here, such as patchy atrophy of the choroid, which at a later stage would be undiscoverable, but which would affect the result of an operation. When the opacity becomes general, the maturity, or ripeness, of the cataract is to be carefully estimated according to the tests already given. Complete maturity gives the best prospect of a successful operation, and should usually be waited for. When the cataract in the one eye is well in advance of that in the other, this commonly involves no great hardship, for the one eye is ready before the other has lost all useful sight; but when the opacity is equal in the two eyes, waiting for maturity may mean a long and trying time of partial blindness, during which the patient's means of livelihood may be cut off, and the health and spirits much depressed. In such cases the ripening may sometimes be hastened artificially in a way which will be described further on, and an operation may sometimes be ventured on before complete maturity is attained. If one eye only is affected and the patient is advanced in years, an operation should not, in the writer's opinion, be recommended; if perfectly successful it will rarely enable the two eyes to work well together, the one requiring a cataract-glass, the other none, and it is to be borne in mind that failure of the operation followed by sympathetic mischief in the good eye, though not a likely result, is still a possibility.

Before the removal of a cataract is undertaken, the soundness of the eye in other respects must be carefully tested. Cataract, however dense, never abolishes perception of light. If the retina be healthy, the patient, when placed with his face to the window, will perceive the shadow of a hand passed before his eyes; and in a dark room he will usually be able to indicate the position of a lighted candle, or of an ophthalmoscope throwing light upon the eye at a distance of two or three feet. If all perception of light is wanting, an operation will be useless. A ready response of the pupil to light and to atropine is favourable; a small and rigid pupil, unless it be adherent, indicates degeneration of nerves or of vessels, and a somewhat greater liability to bleeding and to inflammation of the iris. In such cases it is best to prepare for the extraction of the lens by performing an iridectomy some weeks previously. It is never advisable to extract a cataract from both eyes at the same time, for, should both do badly, the disaster is absolute and final, whereas a failure in the case of a single eye not only leaves a second chance still open, but will not improbably suggest some modified proceeding, which will give a better prospect of success for the second eye.

In all cases of cataract the cornea should be carefully examined under focal illumination. A nebula, so slight as easily to escape notice while the opaque lens is behind it, may materially affect the acuity of vision after the operation. It need be no bar to operating, but the patient should be informed beforehand of its presence and of its probable effect on his sight after the cataract is removed. The state of the eyelids and tear-passages must also be noted; a chronic discharge from either, especially if purulent, exposes the eye to a risk of destructive inflammation after operation, and must be remedied beforehand as far as possible. When any complication of this kind persists, in spite of treatment, disinfectants of one kind or other must be assiduously used to the conjunctiva, both before and after the operation. Of the various disinfectants which have been recommended for use in ophthalmic surgery, boracic acid, either in powder or in saturated watery solution, and iodoform as a very fine powder, are among the best. Some authorities, especially among the Germans, advocate a rigid antiseptic treatment in all cases—e.g. washing out the conjunctival sac with carbolic solutions, immersion of all instruments in absolute alcohol, the spray during the operation, medicated dressings of various kinds after it, and so forth; but the evidence advanced in favour of these measures has not been sufficiently strong to lead to their routine adoption in this country. Finally, the bodily health of the patient must be considered before an operation for the extraction of cataract is recommended. Temperate habits, good digestion, and freedom from serious organic disease will strongly favour a good result, but it is not necessary to abstain from operating, even though there be pronounced cardiac or pulmonary mischief, provided the patient have the prospect of some years of life. Diabetes appears to add little, if at all, to the risks of a bad result. Chronic albuminuria, on the other hand, increases the danger very materially. Advanced age is of itself no contra-indication, provided there is no extreme feebleness. Many perfectly successful extractions have been done in persons more than eighty years old.

Operations for Hard Cataract.—A hard cataract can only be removed through an opening of considerable size. The aim of the surgeon is to incise the tunics in a manner which, while it permits the lens to escape readily, offers the best conditions for healing, and the least danger of destructive inflammation. Very many modes of operating, differing more or less as regards the size, the form, and the position of the incision, and the manner of dealing with the iris, have been practised and described. Two distinct types are represented by the operations known as the 'flap extraction' and the 'peripheral linear extraction.' Each of these goes to an extreme in avoiding the drawbacks which belong to the other, and experience has shown that the best operations lie somewhere between the two. The subject will be best explained, therefore, by describing first these two typical, but extreme, modes, and then the modifications which are in more general use.

Flap Extraction.—The incision is made at the margin of the cornea, or just within it, and forms a semicircular flap, either of the upper or the lower half of the cornea. The speculum and fixing-forceps may be used, or, as was formerly always done, the globe and one of the lids may be fixed by the operator's fingers, the other lid by those of his assistant. The triangular knife is entered at, or just within, the outer margin of the cornea, and carried across the anterior chamber in a plane parallel with the iris, until it emerges at a point diametrically opposite to the point of entrance; it is then pushed steadily onwards until, by reason of the increasing width of the blade, it cuts its way out and completes the semicircular flap. The cystotome is then passed into the anterior chamber, and the capsule is opened; the body of the lens, escaping from its sac, then comes forward through the pupil, rotating somewhat upon its transverse axis as it does so, the edge nearest to the wound appearing first, and escapes from the eye. If the escape does not occur spontaneously, it is effected by making slight pressure on the globe.

When the wound heals favourably, and no inflammation follows, the result of extraction by the flap method is more perfect, as regards the appearance of the eye and the condition of the pupil, than can be attained by any other mode of extraction. But there are many dangers, and when the flap extraction was commonly practised failures were more numerous than they are now. The shape of the incision is unfavourable to ready coaptation of its lips, and allows of gaping upon the occurrence of the slightest pressure from within, as during coughing, vomiting, or straining of any kind; the extensive separation of the corneal tissue from its source of nourishment exposes it to great risk of non-union and destruction by suppuration; prolapse, and incarceration of the iris in the wound, occur readily, and may lead to iridocyclitis; the mechanical bruising of the iris during the exit of the cataract is apt to set up inflammation, and to lead to closure of the pupil.

Peripheral Linear Extraction (Von Graefe).—This operation embodies the principles by which the dangers attaching to the foregoing are to be avoided. The incision, instead of being a semicircle, is, as nearly as possible, a straight line, for the more the curvilinear form is got rid of, the less does the wound tend to gape, and the more likely is it to unite smoothly. Instead of being placed wholly in the nonvascular cornea, and cutting off the nutrient supply from one half of this membrane, it lies almost entirely in the sclera, and corresponds to not more than one-third of the circumference of the cornea. The portion of the iris adjacent to the wound is excised; this not only obviates the bruising which occurs when the pupil is entire, but enables the cataract to present more easily in the wound, removes in great part the tendency to prolapse, and lessens the likelihood of the pupil becoming occluded should iritis follow the operation. As will be seen, however, it is not free from special dangers of its own. The instruments required are the stop-speculum and fixing-forceps; a linear knife, 2 mm. broad, about 30 mm. long, and as thin as is consistent with strength; curved iris-forceps; iris-scissors; a cystotome, the best form being that which is bent at an angle so as to clear the brow, the bend being different for right and left eye; and a curette or spatula. There should also be placed ready to the hand a small but stiff pair of scissors, with which to enlarge the wound in case of need; a scoop to remove the lens with, should it fail to present in the ordinary way—the kind known as the vectis (B. Taylor), which is merely a wire loop, being the best, because it occupies the least space inside the eye; and a small, sharp lens-hook, sometimes required for a similar purpose.

The operator stands behind the patient's head, and makes the incision with his right hand for the right eye, with his left hand for the left. The lids being secured in the usual way, the conjunctiva is seized below the lower margin of the cornea, and the globe turned gently downwards far enough to expose the sclera above the cornea. The knife, with its edge turned upwards, is entered in the sclera at a point about 1·5 mm. external to the outer and upper margin of the cornea, and 2 mm. below the level of an imaginary line drawn horizontally through the highest point of the corneal margin. It is directed in the first place, not towards the intended counter-puncture, but towards the centre of the pupil, so as to make the internal dimension of the wound as large as possible. As soon as the point has passed well into the anterior chamber, the direction of the knife is changed, and it is carried across the upper part of the chamber and out through the sclera in such a way as to effect a counter-puncture exactly corresponding in position with the puncture. The edge of the blade is then turned slightly forwards, and gentle sawing movements are made, till it cuts its way out with a minimum amount of force, and without any sudden jerk, exactly at the junction of the cornea and sclera. The conjunctiva, which still remains to be divided, unless the apex of the incision lie just within the visible margin of the cornea, is severed in the form of a small flap by a few more to-and-fro movements of the knife. This completes the first act of the operation. The incision thus made, if measured externally in a straight line, will have a length about equal to the transverse diameter of the cornea; its extremities will lie in the sclera, its middle portion will pass almost entirely through corneal tissue; it will have a minimum amount of curvature, hence its name 'linear.' The second act is the iridectomy. If necessary, the fixing-forceps are given to the assistant, who rotates the eye gently downwards, while the operator passes the forceps closed into the chamber, if the iris be not already prolapsed, and seizing the pupillary border of the iris opposite to the centre of the wound, draws it gently out, and cuts it off. Some operators remove the iris-segment by separate snips at the two extremities of the wound; others by a single snip, with the scissor-blades lying parallel with the incision. Seeing that the object is to make a perfectly clean but not a very extensive excision, the single snip, which is quick and easy, is to be preferred; but the blades should lie across and not along the wound.

The third act is the laceration of the capsule. The operator resumes the fixing-forceps, and passes the cystotome into the chamber on the flat, taking care that its blunt side is in advance of the point, lest the latter should become engaged too soon. Arrived at the farther margin of the pupil, he turns the point towards the capsule, and, without sensible pressure upon the latter, crucially divides it as freely as possible. It is important not to make a triangular flap of capsule with its base at the wound, as such a flap would readily prolapse, and, becoming incarcerated at the cicatrix, might be the cause of serious mischief later on. The fourth act is the delivery of the cataract, or of so much of it as remains, for more or less of the softened cortex often escapes immediately after the capsule is opened. Gentle pressure is made immediately below the cornea with the back of the curette, or, if it be preferred, with a tortoiseshell or india-rubber spoon, which should cause the wound to gape a little, and the upper edge of the nucleus to present itself. The pressure is cautiously increased, and as the cataract moves upward, it is followed up by the curette over the surface of the cornea. The moment the largest part of the cataract has passed the opening, the pressure is diminished, and the delivery is completed with the utmost gentleness, the cataract being helped out, if necessary, with a touch of the curette. If it be necessary to retain a hold of the conjunctiva during the delivery of the cataract, the pressure may be made with the fixing-forceps, the curette being used at first upon the upper lip of the wound to make it gape, and then upon the cornea to stroke the cataract out of the eye. Some operators remove the speculum before delivering the lens, and, telling the patient to look towards his feet, make the necessary pressure by a finger on each lid.

The cataract being removed, the eyelids are closed for a few moments so as to rest the eye, and to allow the anterior chamber to refill with aqueous humour. They are then reopened, and the operation is completed by the removal of any cortical fragments which may still be visible in the pupil, and by cleansing the wound of any tags of iris which may be retained in it, and the surface of the eye of blood-films. A few rotatory movements of the finger on the upper lid will tend to bring cortical fragments into the pupil, and then, while the patient looks downwards, these are extruded by an upward stroking movement of the lower lid upon the cornea. Much pains must be bestowed on this cleansing of the pupil, but instruments should not be introduced into the eye. An incarceration of the iris will often disappear under a similar stroking with the lid over the angles of the wound; if not, a fine spatula must be used. Blood-clots should be picked from the conjunctiva with the iris-forceps. A drop of atropine is instilled, and the lids are finally closed. Some surgeons use eserine before the operation, and once or twice after it, with the idea of diminishing the risk of prolapse of the iris; against the advantage so aimed at must be set the fact that eserine increases the bleeding after the iridectomy, and probably the tendency to iritis afterwards. The dressing consists of a soft circular pad of absorbent cotton wool between layers of gauze laid over each eye, and held in place by several turns of a roller bandage made of flannel or some other slightly elastic material, the pressure being light and equable. The patient is instructed to lie in bed, either on his back or turning towards the side not operated on, and to avoid all straining movements. If no severe or lasting pain be complained of, the dressing need not be disturbed for forty-eight hours, and then if there be no swelling of the lids, it is sufficient to place a drop of atropine at the inner canthus, and to bandage as before. If all be well, the patient may sit up for an hour or two on the third day, and gradually resume his usual hours. A daily action of the bowels should be obtained by aperients if necessary. Light must be excluded from both eyes for three or four days, and from the operated eye for at least ten days. A deep shade, and, later, tinted glasses, are substituted for the pad and bandage as the eye gains strength. Spectacles should not, as a rule, be allowed under three months after the operation.

The peripheral linear operation, as above described, obviates the special drawbacks of the old flap, but is apt to err in the opposite direction. The incision, lying as it does almost wholly in the sclera, may easily pass beyond safe limits and create a risk of sympathetic inflammation in the fellow eye. The divided vessels sometimes bleed freely into the anterior chamber. The exposure of the suspensory ligament predisposes to rupture and an escape of vitreous. With regard to details, therefore, the operation is at present modified in a good many different ways, of which the following are the most important.

The incision is now often made exactly at the sclero-corneal margin, and of such extent that its extremities lie 3 mm. below a horizontal line passing through the summit of the cornea. The points for the puncture and counter-puncture in this incision are found by laying the blade of the knife, which is 2 mm. broad, horizontally across the cornea, so that 1 mm. of clear cornea remains exposed above it (De Wecker). This is known as the short, or 3 mm. flap. An iridectomy must be performed, but need not be very extensive. The wound adapts itself well, but it sometimes proves a little smaller than is desirable. To avoid this, the puncture and counter-puncture may, when necessary, lie 1 mm. external to the corneal margin. In another form of incision at present a good deal practised, the puncture and counter-puncture lie in the sclera, while the remainder passes through the cornea at some distance from its edge.

The iridectomy is sometimes performed three weeks or longer before the extraction of the cataract. It is then called *preliminary iridectomy.* An incision not more than 4 or 5 mm. long, made with a keratome, suffices, and the cicatrix resulting from it may be disregarded when the extraction is undertaken. This division of the operation into two parts is probably the safest of all methods. A properly performed preliminary iridectomy is almost absolutely devoid of danger to the eye; should serious reaction occur, the surgeon may feel almost sure that an attempt to extract the cataract at the same time would have destroyed the eye. The extraction is facilitated by the previous iridectomy, for there is no bleeding from the iris, and the risk of employing an assistant to fix the globe in presence of a large incision is done away with, for at no stage is a third hand needed. Against the method may be urged the delay, and the chance of disappointment to the patient at the want of apparent result from the first operation. If the iridectomy be made many months before the extraction, there appears in some cases to be an increased liability to rupture of the suspensory ligament and escape of vitreous. A cataract previously immature will sometimes ripen rapidly after an iridectomy; and, with this end in view, a proceeding known as *artificial ripening* is sometimes practised (Förster). Immediately the iridectomy is completed, and while the anterior chamber is still nearly empty, the cornea is stroked with as much firmess as is judged safe with the smooth knee of a strabismus-hook; by this means the anterior cortex is kneaded, as it were, through the cornea, and its splitting up is expedited. The method is often effectual, but involves a distinct risk of setting up iritis by bruising the iris.

Difficulties, accidents, and complications.—The aperture of the lids is sometimes too small to allow of easy access to the sclero-corneal junction; division of the outer canthus is useful in such cases. Holding the lids away from the globe by means of the speculum, the operator transfixes the tissues with a cataract-knife or bistoury from the conjunctival surface, and bringing the point out through the skin divides them freely; bleeding follows, but soon ceases. The lids can then be opened more widely. If the knife be improperly directed within the anterior chamber and the counterpuncture made in a wrong place, it must be withdrawn until the point is disengaged and a second counterpuncture must be made. Should it be necessary through any carelessness to withdraw the blade entirely, no further incision must be made until the anterior chamber is refilled and the aperture closed. The aqueous may escape and distend the conjunctiva like a bladder the moment the counterpuncture is effected, and the iris may sometimes double itself upon the edge of the knife; these occurrences are not serious, and the incision is to be deliberately completed without regard to them. Downward rotation of the eye must be accomplished with the aid of the patient's own efforts, if he be not anæsthetised—never in opposition to them. Dragging upon the globe, especially after the incision is completed, is almost sure to rupture the zonula.

If, when the cystotome is applied to the capsule, the lens is seen to move as a whole with the pricker, dislocation of the cataract and escape of vitreous are imminent. If the cataract do not at once present, it must be removed by a traction instrument—the vectis or the sharp hook—passed carefully but quickly behind it. When the delivery of the cataract is attempted the wound may prove too small. Undue force is dangerous, and bruising of the lips of the wound is likely to lead to suppuration. It must be lengthened at one end by a careful cut with the scissors. An opaque lens is always, or nearly always, smaller than a healthy lens at the same time of life, otherwise the difficulties of extraction would be greater than they are; but in the period of swelling which sometimes precedes complete maturity, the size is probably not far different from that of the normal lens. The so-called 'black cataract' is an exception to the rule; it is not really a cataract at all, and probably has the full size of the healthy lens. If the anterior chamber fill with blood after the iridectomy, light pressure on the outer lip of the wound will sometimes clear it; if this prove unsuccessful, the operation must be completed in spite of the cataract being hidden.

Escape of vitreous denotes rupture of the zonula or posterior capsule, and of the hyaloid membrane. It may arise from the wound being too peripheral, or from undue pressure on the globe. It is more likely to occur in stout, short-necked persons with turgid veins and prominent eyes, than in thin, hollow-eyed, aged people. Collapse of the cornea, on the completion of the incision, is a sign that the contents of the globe are not driven forwards either by the elastic shrinking of the sclera, or by pressure from without; it may be taken as a sign that escape of the vitreous is not likely to happen. In old people with greatly degenerated vessels, especially in drinkers, we may anticipate an unsound condition of the zonula and vitreous, which will almost inevitably lead to loss of the latter. If vitreous fluid escape before the lens, the danger of losing the latter altogether is great; the cataract must, if possible, be immediately removed by traction, as above explained. An escape of vitreous together with the cataract, or after it, is not necessarily detrimental, unless other harm have been done; but it probably predisposes to deep-seated changes both at the time and later, and should always be avoided if possible. In rare instances immediate and copious bleeding takes place from the deep vessels; the eye is thereby lost, and should be excised as soon as possible.

The pain after the operation is usually not severe; it should subside after a few hours. Severe and increasing pain after the first six or eight hours is a sign that things are going wrong, and the eye must be examined. The complication most to be dreaded is suppurative inflammation, beginning at the wound. If this occur, the lips of the wound will show a yellowish infiltration, and may be coated with shreds of muco-pus; the conjunctiva will be swollen, the aqueous more or less turbid. Unless the suppuration can be immediately checked it is likely to involve the whole of the cornea and to spread to the iris, ciliary processes, and cornea, ending in destruction of the eye by panophthalmitis and subsequent shrinking. In the most favourable case it is likely to damage the cornea, and to leave a closed pupil with dragging of the iris towards the cicatrix. The inflammation is probably of septic origin, and a vigorous disinfecting treatment should at once be adopted. But this is not the only indication; an eye which easily succumbs to septic influence is probably an eye of feeble vitality, and every possible effort must be made to improve its nutrition. The lids being carefully separated, the surface of the eye is to be cleansed from pus by means of warm water or boracic acid lotion several times during the day; after each cleansing, finely-powdered iodoform should be dusted on to the conjunctiva and outside the lids; and then a hot fomentation should be applied. The conjunctiva, if much swollen, should be incised lightly with a cataract-knife, or scissors, to give escape to blood and serum, and at the same time a good nourishing diet, with a liberal allowance of alcohol in the form most acceptable to the patient, should be given. If there be much pain, ease must be given by morphia. Some Continental authorities have lately advised still more vigorous measures, namely, opening up the wound and injecting the anterior chamber with a saturated solution of boracic acid, or a 5 per cent. solution of salicylic acid, at intervals of eight or twelve hours (Horner), and again, by applying the platinum wire galvano-cautery heated to a white heat to the whole length of the wound (Abadie).

Iritis, apart from that which occurs with suppurative inflammation, is a common complication. It is usually caused by the irritation of cortical substance remaining in the eye, but is greatly furthered by systemic disturbance, such as may arise from constipation, lithiasis, chill to the surface, loss of sleep, and emotional upset; it may also arise from incautious exposure of the eye to light too soon after the operation. One or two leeches to the temple or lower eyelid, a purge, atropine six or eight times during the twenty-four hours, with careful protection of the eye and head from draught, are the chief remedies. The iritis is of the plastic variety, and often causes more or less occlusion of the pupil. If it be so severe as to involve the ciliary processes, and be accompanied by much loss of tension, the eye is in great danger, and there is the further danger of sympathetic ophthalmitis. Incarceration of the iris in the cicatrix is likely to cause iritis and prolonged irritability of the eye. Usually it leads to some irregularity in the surface of the cicatrix; the tissue which unites the lips of the wound bulges at one or more parts, and may become prominent along its whole length, a condition known as a cystoid cicatrix. The bulging part may be punctured with a needle a time or two, so as to evacuate the anterior chamber, and thus, by lowering the pressure on its inner surface, to give it a chance of contracting. If it persistently recur, the tension of the eye will probably be found to be in excess, and the cause of this may be looked for in a partial obliteration of the angle of the anterior chamber. The proper remedy is then either an iridectomy, or a sclerotomy. Moderate prominence of the cicatrix is not of itself dangerous to the eye, but it exposes it to risk of easy infection from without, and destruction by suppurative inflammation extending to the uveal tract. Inversion of the edge of the lower lid to such an extent as to irritate the eye sometimes occurs during recovery from cataract-extraction. It may usually be remedied by coating the outer surface of the lid quite up to its margin with collodion, so as to cause strong contraction of the skin; the application must be repeated from day to day.

After recovery from the operation the pupil is left, in the most successful cases, entirely free from opacity of any kind; in a considerable proportion of cases it is occupied by a more or less opaque membrane consisting of retained lens-matter, or inflammatory exudation adhering to the capsule and iris. Such obstructions are sometimes spoken of as secondary cataracts; it is better, however, to use the terms primary and secondary cataract only as they are used above, i.e. in the sense in which they are used also in relation to glaucoma, and for the conditions in question to use the terms secondary capsular membranes, capsular opacity, or closed pupil, or to designate them by the general term *after-cataract*, the equivalent of the German 'Nach Staar.' They are dealt with differently according to their density. The thinner films are readily divided with two discision needles. When the iris is adherent to the obstructing membrane, iridotomy gives the best results with the least risk. *See* IRIS, Diseases of the. In all cases the cut should be across the fibres of the iris as far as may be, not in the direction of their length; their retraction on being severed then serves to widen the aperture. Instead of iridotomy the following method (Noyes) is sometimes available. A linear cataract-knife is passed through the cornea near to its outer margin and out again near to its inner margin by puncture and counter-puncture; before it is withdrawn from the chamber its point is made to perforate the opaque membrane. A blunt iris-hook is passed in through each of the corneal apertures and through the puncture in the membrane, and then, by drawing the two hooks apart, the latter is torn more widely open without dragging on the ciliary processes.

TRAUMATIC CATARACT.—In all cases of injury to the eye involving damage of the lens, the first object of treatment is not to deal with the cataract, but to save the eye from destructive inflammation. If there be a prolapse of the iris which cannot be reduced, it is usually best to excise the prolapsed portion as fully as possible, making an incision, if necessary, as for an ordinary iridectomy, in order to prevent its incarceration in the cicatrix. To prevent iritis, atropine should be used freely and frequently; iodoform in fine powder should be dusted upon the wound, to lessen the risk of septic inflammation; and iced compresses should be applied over the closed lids. If there be much injection, two or three leeches should be applied at once to the temple. Next to the danger of destructive inflammation is that of the onset of glaucomatous tension. The older the patient and the more rapid the swelling of the lens, the greater is this danger. In the absence of any serious complication of either kind, no operation for the removal of the cataract should be undertaken until the irritability of the eye has quite subsided; but if inflammatory symptoms set in, or if the eye becomes hard, the lens must be removed as soon as possible. The operative treatment of a traumatic cataract is the same as for an ordinary cataract at the same time of life. In many of the more severe injuries involving the lens, the most urgent question is whether the eye should not be at once removed in order to preserve its fellow from the danger of sympathetic ophthalmitis. For the indications to be followed in such cases *see* SYMPATHETIC OPHTHALMITIS.

PRIESTLEY SMITH.

CATARACT-GLASSES.—Aphakia, or absence of the crystalline lens, involves, in almost all eyes, a high degree of hypermetropia, and in all eyes an absolute want of accommodation. The final step in the treatment of a case of cataract is, therefore, to prescribe glasses which neutralise these deficiencies. An emmetropic eye will, after removal of its lens, in most cases require for distant vision a spectacle-lens equal to about 11 dioptres (3½ ins. focus), and for reading one of about 16 dioptres (2½ ins. focus). Theoretically it might appear that, in the absence of accommodative power, a different lens would be required for every different distance, but practically two are enough, for the effective power of each can be varied considerably by placing it further from or nearer to the eye; the further from the eye the greater the power obtained, and *vice versâ*. Thus, with his distance glass, the patient can accurately focus objects 3 or 4 feet away by placing the spectacles a little further down his nose, and with the reading glass, which is usually focussed for 10 or 12 inches, he can get clear vision at a shorter distance by the same means. Eyes previously hypermetropic will usually require stronger glasses than the foregoing; myopic eyes will require weaker ones; but the strength of the glass required to produce emmetropia after removal of the lens bears no very exact relation to the pre-existing condition of refraction, for the lowering of the refraction produced by loss of the lens is not the same in all cases; a pre-existing myopia may depend on elongation of the eyeball, or upon changes in the lens itself arising with the onset of the cataract. In cases of very high myopia (far point at about 3 ins.) the removal of the lens may bring the eye into the emmetropic condition. In many cases the operation produces another refractive change, viz. corneal astigmatism. This may arise either through imperfect coaptation of the lips of the wound or swelling of the corneal or scleral tissue, or through traction upon them from within by pupillary membranes. The maximum acuity of vision is not attained until the astigmatism is corrected by an appropriate glass, but such correction should not be made too soon, as the degree of the astigmatism is apt to alter during the first few months. In some cases it is sufficiently corrected by merely sloping the ordinary spherical glass.

The acuity of vision after a cataract operation as tested in the usual way may reach $\frac{20}{20}$, or may fall short of that standard by any amount; $\frac{20}{70}$ may be considered a good result, but a lower degree than this will be appreciated as a boon when previously the patient has been unable to make his way about without help. Even when $\frac{20}{20}$ is obtained the operation is not to be credited with having restored a retinal picture equal to that in the normal-sighted eye, for the aphakial eye armed with a cataract glass obtains a larger retinal picture of a given object at a given distance than the normal eye. Priestley Smith.

CATARRH OF THE BLADDER. *See* Bladder, Diseases of the.

CATARRH OF THE EAR. *See* Ear, Middle, Diseases of the.

CATGUT LIGATURE. *See* Ligatures.

CATHETERS are hollow instruments for emptying the urinary bladder. They are tubes constructed of silver or of flexible material. The silver instruments are about eleven inches long, of equal thickness throughout; closed and rounded at one end (the beak) to slide along the urethra, and furnished with two rings near the open end (the mouth) to which tapes may be attached when the catheter has to be retained by the patient. About a quarter of an inch behind the beak two slits are cut —the eyes—to allow the urine to enter the catheter when the beak has passed into the bladder. For eight inches from the mouth the instrument is straight; but the last three inches are bent round a fourth of a circle which has a diameter of four inches; so that the beak is placed at a right angle with the direction of the stem. As the rings near the mouth are fixed on each side of the stem, they indicate the direction of the beak, which is in a plane parallel to that of their openings. Each instrument has a wire stylet. The catheters range in size from No. ¼ English to No. 12; the first has a diameter of 0·06 inch; the latter, 0·25 inch. Larger ones than these are seldom employed. This, the English scale, does not advance in equal steps, and also varies with different makers. The French scale ranges from No. 1 to No. 40, and each numeral denotes the circumference of the catheter in millimètres.

The flexible catheters of woven silk have two principal forms. The English, so-called 'gum elastic,' are of the same thickness throughout, have an eye near the beak, and are mounted on a wire stylet. Highly flexible when warm, they stiffen when cold, and thus can be given any required curve, which they will retain until again heated. The French flexible catheters taper for the last three inches to the beak, becoming very pliant and fine near the point. The beak itself is rendered blunt by ending in a small swelling or 'olive'; hence the name 'olivary' applied to these catheters. They retain their pliancy in all cases, and cannot be made to adopt a curve. A well-shaped one should be very smooth, have eyes with nicely-rounded edges; and when the point or beak meets an obstruction, the flexible neck behind it should yield at once in a sharp bend, not in a gradual curve.

Besides these two forms there is the so-called 'sonde coudé' or elbowed catheter. Made of the same flexible material, this is bent half-an-inch behind the beak to an angle of 45° with the stem, and this bend is sometimes again bent half-an-inch further back, when the catheter is termed 'bi-coudé,' or doubly-elbowed.

Catheters are also made of vulcanised india-rubber or of celluloid. The former are valuable from their extreme suppleness; the latter from their smoothness and insusceptibility to roughening by phosphatic incrustation. *See* Bougies.

Berkeley Hill.

CATHETERISM.—The art of passing catheters. This is practised in various ways, according to the different conditions of the urethra and neck of the bladder which render the artificial evacuation of the bladder needful. These conditions are described in the articles on Bladder; Prostatic Hypertrophy; Retention of Urine; Stricture of the Urethra, &c.

CATLIN.—An old form of amputating knife, having a narrow straight blade with a double cutting edge. It was used chiefly in amputations of the leg and forearm.

CAUSTICS, agents used for the destruction of tissue, may be classified in two divisions, viz. chemical and thermal. The latter includes the galvanic and actual cautery, which are treated of in the article Cautery. The chemical or 'potential' caustics may be arranged in three main classes, viz. alkaline, acid, and mineral.

I. The Alkaline Caustics include (1) Potassa fusa, hydrate of potash, caustic potash.

(2) Hydrate of soda, caustic soda.

(3) Lime, dehydrated, unslaked or quick.

Various combinations of these have been devised, such as 'Vienna paste,' which is made with quicklime, 2 parts; caustic potash, 1 part; mix just before use with sufficient alcohol to form a soft paste. 'Caustique Filhos,' lime, 1 part; caustic potash, 2 parts; prepared in moulds. 'London paste,' lime and caustic soda, equal parts.

(4) Ethylates of sodium and potassium.

All these act mainly by virtue of their great affinity for water, withdrawing it from the tissues with which they are brought in contact; they also readily decompose and dissolve the nitrogenous components. Potash and soda have a high diffusive power, and are not neutralised by the natural fluids of the tissues, which are themselves nearly all alkaline, therefore their action tends to spread. In their effects they are *deep*, as distinguished from *superficial* caustics; the slough produced is dark, moist, and leathery; the potash compound is more powerful than the soda.

The action of quicklime is less diffused and more superficial, and on the skin proper not very severe; but when applied to mucous membranes it causes much pain and an extensive slough. The addition of lime to the caustic alkalies, as in the pastes described, serves to render them less deliquescent, and so to keep their effect more under control.

The ethylates act in a similar but more limited manner, and with less pain, especially if opium be combined with them; a solution in spirit is commonly used, and on first contact causes only redness; but when the textures part with water, caustic soda (or potash) is immediately formed, and destruction of tissue commences.

II. The Acid Caustics include the mineral acids—nitric, hydrochloric, sulphuric, chromic, and manganic; and the organic acids—carbolic, glacial acetic, pyrogallic, and salicylic; with which may be grouped iodine and bromine. The mineral acids act only superficially if lightly applied, destroying the epidermis; but if kept in contact, they penetrate and destroy the tissues deeply, abstracting water from them, coagulating albumen, and combining with alkaline bases; the latter effect limits their caustic action.

Hydrochloric acid penetrates less deeply than nitric or sulphuric acid, and the slough produced by it is at first white; that of sulphuric acid is brown and firm. Nitric acid turns the part yellow, picric acid being formed in the tissues. Chromic and manganic acids and their compounds act almost wholly by oxidation; from the former, when applied over an extensive ulcerated surface, absorption, with serious symptoms of vomiting, diarrhœa, and collapse, has occurred. The same may be said of strong solutions of pyrogallic acid.

Chromic acid is slow in action, but not extremely painful, though it penetrates deeply; it requires care in protecting neighbouring parts. Made into a paste with a little water, it turns the skin yellow, brown, and, later, black, and causes a slough which is detached in one or two days.

Glacial acetic acid is much more superficial in action, often producing only vesication; it is, however, a useful application to warts and callosities, destroying them in successive thin layers. A special formula containing it, used for syphilitic warts, bears the name of Plenck, and is as follows:—℞. Alcohol, acid acetici āā fʒss., hydrarg. perchloridi, aluminis, camphoræ, plumbi carbonatis, āā ʒss., to be applied carefully twice daily.

Carbolic acid, the action of which is also superficial, is not often used as an escharotic, but is employed pure or mixed with sufficient liquid for solution as a moderately caustic astringent to the cervix uteri, and, combined with one to three parts of spirit, is much esteemed by Hardy in superficial lupus; it penetrates the tissues, but not so deeply as potash; it is less painful and leaves a smoother scar. The pure acid injected into the slough of a furuncle or carbuncle allays pain, limits the inflammation, and hastens the separation of the slough.

Salicylic acid is much milder in effect. It is doubtful whether it forms a compound with albumen or not; but when applied in strong solution to previously cut warts and corns, the base of these separates in layers. It is more useful in post-mortem warts, though it causes some smarting pain for a short time after its application; it must be re-applied daily until the growth disappears. It is very irritant to mucous surfaces, but is well tolerated in some cases; ulceration of the throat has been caused by its internal administration.

Iodine in strong solution is occasionally used for its caustic properties, especially in snake-bite; and a solution in oil of tar—one or two drachms to the ounce (Coster's paste)—is an efficient, though painful, application for ringworm; it often vesicates.

Bromine is much more powerful, quickly oxidising and destroying organic tissues, coagulating and combining with albumen, and forming a brownish slough. Bromide of potassium, sprinkled in fine powder over an ulcerated surface, acts as a mild caustic with advantage (chlorate of potash is also used in the same manner).

III. The MINERAL CAUSTICS include the following:—

1. *Arsenious acid or oxide* (*white arsenic*), which is used either mixed with 3 or 4 parts of mucilage, or combined with mercury, as in the following pastes or powders, named after their inventors; but their ingredients may be varied somewhat according to the case. Cosme's: Cinnabar, 2 parts; arsenious acid, 1 part; powdered pterocarpus draco (dragon's blood), 2 parts; made into a paste with mucilage. This is similar in composition to the arsenical powder of Dubois, but contains proportionally more arsenic. Dupuytren's powder is made with arsenic 4 to 10 parts; and calomel 90 to 100 parts (by weight). Miss Plunkett's contains Ranunculus acris and flammula, of each 1 ounce; arsenious acid, 1 drachm; sulphur, 100 grains; worked into a paste and dried in the sun. There are many other empirical formulæ, of which Manec's is still used in France, and is made as follows:—Arsenic, 1 part; cinnabar, 5 parts; burnt sponge, 2⅓ parts; made into a thick paste with water. That of Frère Come contains the same ingredients, but has 1 part of arsenic to 4 of cinnabar and 10 of charcoal.

2. *Acid nitrate of mercury* is perhaps the best and most manageable liquid caustic.

3. *Mercuric chloride* (corrosive sublimate).

4. *Chloride of antimony* (butter of antimony) is not now much used; but has the advantage of penetrating well and of not producing much pain or inflammation, and after the separation of the eschar, a clean, healthy surface is left. A preparation of it, formerly celebrated, but now little, if at all, used in this country, is the paste of Landolfi, which was made with 1 drachm of chloride of bromine, 2 drachms of chloride of antimony, and 3 drachms of chloride of zinc, mixed with sufficient liquorice powder to form a paste. According to another, and probably original, formula, an equal part of chloride of gold is substituted for the zinc. Hebra, however, discards the metals, and his 'modified paste of Landolfi' contains only concentrated hydrochloric acid with sufficient liquorice powder to form a paste.

5. *Chloride of zinc.*—Canquoin's Paste, as used by Liston:—Chloride of zinc, 1 part; wheaten flour or plaster of Paris, 2 to 3 or 4 parts, according to the strength desired, and water sufficient to make a paste. This caustic destroys the part in a

direct ratio with the thickness of the layer applied.

Fell's Paste:—Chloride of zinc, 1 part; extract of sanguinaria, 1 part; extract of stramonium, 2 parts; to be thoroughly mixed.

In preparing the paste used at the Middlesex Hospital, 'Liquor zinci chloridi cum opio' is first made as follows:—Zinci chloridi ʒxvj.; pulveris opii ʒjss.; acidi hydrochlorici f℥vj.; aquam bullientem ad Oj. Macerate the opium in twelve ounces of boiling water for twelve hours; add the acid and filter, then dissolve the chloride of zinc in the filtered liquid, and make up to twenty ounces with distilled water. Two drachms of flour are added for every ounce of liquor, mixed smoothly in a mortar, and heated over a water-bath until of proper consistence.

6. *Sulphate, nitrate, and acetate of zinc.*
7. *Perchloride of iron.*
8. *Nitrate of silver* (lunar caustic).
9. *Sulphate, nitrate, and acetate of copper.*—The so-called 'lapis divinus' is made with equal parts of sulphate of copper, alum, and nitre, fused together with 4 parts of camphor.

The mineral caustics differ somewhat in their mode of action, but resemble each other, to a great extent, in coagulating albumen, and thus arresting vital processes. Arsenic especially illustrates such arrest, its result when applied in suitable form being a 'mummifying of tissue.' With this drug, as with mercury, antimony, and chromic acid, the possibility of systemic absorption has to be carefully considered, serious and even fatal results from general poisoning having followed the application of a 4 p.c. solution to a small ulcer. Hence these agents are not used so much now as formerly.

The chloride of zinc is probably the best solid caustic, and the one now in most frequent use, but it is deliquescent, and apt to penetrate too deeply if used pure; it should therefore be employed in the form of one of the above-mentioned pastes. The nitrate of zinc is commended by Mr. Marshall as penetrating deeper and with less pain; advantages which were claimed also by Sir J. Simpson for the sulphate, the slough produced by which he found to separate earlier than that formed by the chloride.

The stronger solution of perchloride of iron, though commonly used only as a styptic and astringent, acts as a caustic to mucous membranes, and will cause a slough.

Nitrate of silver, which popularly represents the type of *caustic*, acts only as such when thoroughly applied in a concentrated form—e.g. when a solid pointed stick is firmly pressed into a soft tissue until the latter is broken up. A similar remark may be made as to the use of sulphate of copper and its preparations.

USES AND MODE OF APPLICATION OF CAUSTICS.—1. *To make an issue.*—Take a strip of soap plaster with a hole half an inch square in its centre, and apply it over the part to be treated. In the hole place a small piece of caustic potash about the size of a pea, and cover it over with a second strip of plaster, and in two to three hours a slough will have been formed.

2. *To open an abscess.*—The method of proceeding is the same as for an issue, although it is now rarely, if ever, resorted to. Previously to the introduction of the aspirator and antiseptic modes of treatment, this was a favourite method of effecting the discharge of an hepatic abscess, the slow action of the caustic leading to adhesions which prevented the escape of pus into the peritoneal cavity.

3. *Counter-irritation.*—Besides issues, the cautery is a powerful and useful counter-irritant in some chronic inflammations.

4. As a *hæmostatic*, a pointed stick of silver nitrate is serviceable in arresting the bleeding of a leech-bite or the base of an excised wart. For more extensive surfaces the actual cautery, at a dull red heat, is necessary.

5. *For destruction of unhealthy ulcerated surfaces, morbid growths, &c.*

In strumous ulcers with overhanging, thickened edges and slowly extending surface, the application of a caustic alkali to the edges and base is often beneficial, and equal parts of caustic potash and water, as used by Dr. Liveing, is one of the best applications for strumous lupus. The surrounding healthy skin should be protected by plaster or oil, and the cauterised part sponged with dilute acetic acid after the application. Fungating granulations may be rubbed down with solid silver nitrate or copper sulphate; the former is also thrust into the nodules of *lupus* to break down the morbid tissue. Chloride of zinc paste, in any of the forms mentioned, is also much used for *lupus* and *rodent ulcer*, the application being made on a piece of thin linen, and allowed to remain for twelve to twenty-four hours at a time; after separation of the slough by poultices a fresh application may be made. In *hospital gangrene*, and similar cases of rapid sloughing, the part should be scraped with a blunt or wooden knife, and fuming nitric acid applied by means of a glass rod. The mineral acids mixed with charcoal are also suitable, but bromine seems to have special efficacy; after thorough cleansing of the wound a solution may be used containing one ounce of it with two drachms of bromide of potassium, and four ounces of water. The intensely irritant effect on the mucous membrane of the nose and air-passages is its chief drawback.

Hydrochloric acid is a useful application to *cancrum oris*, diphtheritic membrane, ulceration of the tongue, and phagedænic ulceration of the tonsils, and nitric acid to the non-infective chancre; the parts must be only lightly touched with the acid. Small ulcerated surfaces and spots of acne may be treated with the acid nitrate of mercury, which is conveniently applied with a wooden match; this is also very serviceable for outlying nodules of lupus. Morbid growths may be removed by a heated iron driven into and through them in various directions, or by Fell's paste, spread on thin linen, and applied repeatedly after the separation of each slough. When the surgeon wishes to use the paste after a cutting operation, he should staunch the bleeding by the firm application of a pad of lint for twenty-four hours, after which the caustic may be spread on the dry surface. This procedure ensures the efficient action of the paste.

In epithelioma of limited extent, as in other forms of malignant growth, the knife is usually preferred; but in cases where this is inadmissible, a paste of chloride of zinc is very serviceable. If the skin is unbroken it should be destroyed by nitric acid, and the paste introduced through incisions made in the eschar formed. Maisonneuve used a paste, dried in pointed pieces, which could be inserted into and round the tumour; and Paget applied small lancets of wood coated with the previously melted chloride. When the surface is already ulcerated, a zinc paste may be spread over it for a thickness of, say, half an inch, and kept in contact for six or twelve hours, when it will have destroyed tissue to the depth of about one inch. This slough will separate in a week, leaving either a fresh cancerous surface exposed for another application, or a healthy granulating sore. Simpson applied the sulphate of zinc, in powder or mixed with a small quantity of glycerine, one ounce of crystals to one drachm of the latter; he found that the slough usually separated in five or six days.

For quite superficial nævi, a careful application of fuming nitric acid on a glass rod is very successful. The surrounding skin should be protected with oil, and the superfluous acid neutralised with a solution of carbonate of soda. Other mineral acids may be used, or the part may be painted with an arsenical solution or the ethylate of sodium. The latter is very good for the smaller nævi: it causes little pain, and is efficient; no water must touch the surface during its application. The same caustics have been used to obliterate varices. The deep forms of nævi require the actual cautery. C. D. F. Phillips.

CAUTERY.—The cautery consists of a piece of metal, generally iron or platinum, raised to a variable temperature by the heat of a flame or fire, or by some special means, as in the galvanic or in Paquelin's cautery.

It is used for the following purposes: for dividing soft tissues, as in removing portions of the tongue and cervix uteri; for destroying vascular and fungating growths; for arresting hæmorrhage; and for purposes of counter-irritation. The degree of heat employed varies to some extent in each of these cases. Three degrees of heat are recognised—white, red, and black—and it is stated that when heated to the white degree the cautery gives little pain.

A bright red heat is employed for dividing tissues. In all cases this operation must be done slowly, and if hæmorrhage occur, the heat must be reduced and the bleeding points retouched. When the metal is covered with blood and charred tissue, it is difficult, as in Paquelin's cautery, to see the exact colour. The temperature can then be estimated by the rapidity of the cutting and the presence of blood.

For arresting hæmorrhage, a dull red or black heat is the most effective. When a little too cool, the tissues are apt to adhere to the metal, and bleeding to follow its forcible removal. If this occur with Paquelin's cautery, raising the temperature slightly will separate the metal; but with the actual cautery the tissues must be detached by a spatula or blunt director. The surface must during the whole time be kept as dry as possible, the sponge or lint being pressed on the surface, not drawn or rubbed over it, for fear of detaching the eschar.

For destroying growths, a red heat, slightly brighter than the dull red, is used. The tissue is gradually burnt down, the cautery being held in contact with the surface some time, and the part kept dry. In puncturing nævi, when the actual cautery is used, it must be made as hot as possible at first, to penetrate the skin.

For purposes of counter-irritation a white heat is recommended, and is said to produce little pain. The cautery is drawn lightly over the skin in vertical lines. It is employed in disease of the joints, especially of the knee, and also in spinal caries. This mode of application will produce an eschar, the depth of which will depend on the amount of pressure used. A slighter effect may be obtained by holding the heated metal a short distance from the surface, and passing it over more slowly, thus producing a rubefacient action, or even blistering. It is well, in applying the cautery for this purpose, to avoid points where ulceration is likely to be troublesome, as over subcutaneous bones and superficial tendons.

The benzoline or thermo-cautery of Paquelin is now employed for most purposes, and the only precaution necessary in using it is to take care that the point is thoroughly heated in the spirit-lamp before any benzoline vapour is forced into it.

The Galvanic Cautery.—The heat in this cautery is produced by the passage of an electric current through platinum wire, fixed in a suitable insulated handle. This metal, on account of its high fusing point, can be kept at a white heat for some time.

The difficulty of obtaining a constant battery with sufficient power is the practical inconvenience connected with the galvanic cautery. It is also expensive, and requires frequent attention. Except where a cautery-écraseur is required, it is now almost entirely replaced by Paquelin's thermo-cautery.

The battery.—In every battery there should be a small number of cells (four to six), with large acting surfaces. The bichromate of potash battery is the one now most commonly used. The elements are carbon and zinc, the fluid an acidulated solution of the bichromate. When not in use the elements should be raised out of the fluid. This is accomplished in a battery made by Messrs. Meyer and Meltzer by closing the lid. One charge will last for several operations, but so quickly do the elements polarise that the current is uncertain, and liable at any moment to stop. Should such an event happen the working may be renewed by blowing air in with a bellows. This battery has the further advantage that it can be kept in a closed box, there being no acid fumes to destroy the connections.

The Bunsen arrangement supplies a reliable current, and where it can be attended to by an electrician, is no doubt the best. The elements are best arranged in vertical cylindrical jars. The block of carbon—preferably, on account of its porosity, retort carbon—is suspended in nitric acid contained in a porcelain jar. This is placed in a wide vulcanite jar containing water acidulated with sulphuric acid (1–8), and between the two is the zinc plate folded into a cylinder, a gap of about an inch intervening between the edges. The connections are of copper. The objection to this battery is the necessity for decanting the fluids when not in use, since the nitric fumes destroy the connections. If, however, this be done, and the elements carefully washed and the connections dried, the battery will not prove expensive and may be relied upon. Before long probably the necessary heat will be obtained at a moderate cost, from the 'accumulator.' Already Mr. Buchanan has used this electric reservoir, and the writer has maintained a platinum wire at a white heat, for some time, with two of Faure's accumulators. The great weight and the cost prevent the general adoption of this plan at present.

The connections and handle.—The current is conducted through thick copper wires, so as to diminish as much as possible the resistance, to a special handle. This is composed of two brass rods which are insulated by talc fitted in a wooden handle; at the lower end are clamps for connecting the wire, and to the other is soldered, by common solder, the platinum wire. A movable button in the handle works a metal cylinder by which the continuity of the current may be made or broken. This interrupter has been arranged so as also to be worked by the foot.

The shape of the terminal will depend upon the use to which it is to be put. That just described furnishes a point or small loop for puncturing, or cauterising, small surfaces; for larger surfaces the wire is coiled round a porcelain cone. The chief use now of this cautery is for removing growths by surrounding them with a wire. The platinum is made into a loop, the ends carried through two brass tubes and wound round ivory rods by turning a button, so that the tumour can be gradually constricted and burnt through. The current is conveyed through the brass tubes to the wire.

Application.—It is only necessary to describe the écraseur action, and here an advantage possessed by no other cautery is manifest—viz. that the wire can be placed *in situ* before the heat is applied. The loop is carried over the growth, tightened, and the heat applied gradually; if too much heat be used the wire will cut through like a knife, and no time be given for hæmostatic action; therefore the wire must be tightened very slowly. When acting well there should only be heard a low frizzling sound with little smoke.

When the part to be removed cannot be surrounded—as, for example, the tongue—the wire must be carried through at the desired point or points, and the part removed by one or more cuts. The wire is made to traverse the part by a large needle with a sunk loop at one end, or it may be passed through a canula. It is specially used for removing intra-laryngeal, nasal, and uterine growths, and, as said above, for extirpating the whole or part of the tongue affected with malignant disease.

Paquelin's Cautery, invented and introduced by M. Paquelin in 1876, has now almost replaced both the actual and galvanic cauteries.

The essential principle is that platinum, when raised to a certain heat, becomes incandescent when brought into contact with a mixture of air and benzoline vapour. A stream of air is passed, by means of the ordinary spray-bellows, into a bottle containing benzoline, and the resulting mixture of air and benzoline vapour conducted through an indiarubber tube to the cautery. This is hollow, and consists of a wooden handle through which passes a metal tube. To the end of this is attached the indiarubber tube, and into the other is screwed, by a piece of the same metal, a hollow platinum cone. The tip of the platinum is heated in the flame of the spirit lamp until it begins to glow; this ignites the highly inflammable benzoline vapour forced into it by a few sharp compressions of the handball, and the metal is raised in a few seconds to a red heat. The temperature can be maintained for any length of time by gently compressing the ball, and moreover can be regulated to a nicety. The cautery is sold in a compact box containing usually three platinum heads: one wedge-shaped, to act as a knife; a second furnished with a broad button for large surfaces; and a third with a point suitable for puncturing nævi and piles. Various other terminals have been made to suit particular localities; for example, the knife-end is curved and this renders it more useful in cavities, as in dividing the cervix uteri. A scissors-terminal is also made.

It is necessary to use rectified spirit in the lamp, for the double purpose of increasing the heat and preserving the platinum. The benzoline must be of the specific gravity of 0·709, and the bottle never more than half-full. After remaining some time in the bottle the benzoline will not ignite, so that it is well to use a small quantity at a time, keeping the reserve in a special flask. Charters J. Symonds.

CELLULITIS, or Diffuse Cellular Inflammation, may clinically be looked upon as a form of erysipelas, and by many authors is classed as a variety of that disease. It is characterised by the same spreading inflammation and by the same atonic character. It affects, however, only the cellular tissue; occurring in those situations where there is no skin, as in the pelvic cellular tissue, or in the subcutaneous cellular tissue, the skin not being involved, or only secondarily affected, by the inflammation.

It presents itself in its most virulent form after the introduction of a septic poison, as in dissection wounds, or after the bite of one of the less poisonous snakes. It may occur also in the pelvic cellular tissue after wounds or surgical operations, in women, after parturition; and after scalp wounds or injuries of other parts involving the cellular tissue.

When it occurs as the result of a poisoned wound, it possesses the peculiarity that it may attack tissues remote from the wound, and between which and the puncture no direct communication can be traced. Moreover, the puncture may be quite healed or apparently healthy. Thus, in a dissection wound of one of the fingers, the cellular tissue in the pectoral region may be the seat of the disease. When it occurs as the result of a simple wound, it runs the same course as an attack of ordinary erysipelas, starting from the seat of injury, but implicating the cellular planes.

The disease appears as a diffused swelling of the part affected. The swelling, at first œdematous, speedily becomes brawny; or it may be œdematous in some parts, brawny in others. The skin is slightly reddened and presents a mottled appearance, but there is no well-defined limit to the redness. There is great pain, of a tensive, burning character, which is increased by pressure. There is often inflammation of the absorbent vessels and glands. After a time the swelling becomes soft and doughy, and there is an indistinct sensation of fluctuation. Occasionally crepitation may be perceived, from putrefactive changes. The skin later on becomes more involved and of a darker colour, and may, eventually, pass into gangrene, unless relieved by timely interference. The constitutional symptoms are of an exceedingly grave character. There is great excitement and prostration of the nervous system, especially where the disease is the result of the introduction of a septic poison, and speedy collapse. The fever is of a marked asthenic type, with a high temperature, generally profuse sweating, a quick and feeble pulse, a brown and dry tongue, vomiting and diarrhœa, and low muttering delirium.

In extreme cases death results in two or three days, but in those in which the general symptoms are not so severe, it may be delayed for several weeks, or recovery may take place.

The *diagnosis* of the subcutaneous form of this disease is generally simple, but when the mischief is deep-seated it is by no means easy. The presence of an œdematous swelling, accompanied by severe constitutional symptoms and rapid prostration, should always put the surgeon on his guard, and if any reason exists for suspecting the presence of deep-seated cellulitis, an exploratory puncture should not be omitted.

Treatment.—In the treatment of cellulitis decisive measures are necessary, and the only effectual way of preserving the skin and preventing sloughing is by means of incisions. Hence they should be made early, before the parts have lost their vitality. The object of the incisions is to relieve tension and give exit to the effused inflammatory products; and, to attain this end, it is better to make a number of small incisions (say some two or three inches in length) rather than one long cut through the inflamed structures. The incisions should embrace the whole extent of the tense parts. It is desirable that they should be made parallel to each other, and that the extremity of one incision should overlap that of the second, as by this means the greatest relief is given to tension. They must be carried deeply into the infiltrated and gelatinous-looking cellular tissue, and if the disease has extended beneath the fascia, it must be freely incised. After the incisions have been made, warmth and moisture, in the shape of fomentations and poultices, must be applied in order to facilitate the escape of the effused fluids.

As regards general treatment, the free and early administration of tonics and stimulants is necessary. Wine and brandy, combined with bark and ammonia, or other tonics, form the only reliable treatment, and they must be given with no niggard hand.

The issue of a case of diffuse cellulitis will often depend upon whether the patient is able to take and digest large quantities of stimulants. So long as he can do this there is always good ground for hope, and the amount of brandy and wine which patients suffering from this disease can assimilate is sometimes astonishing. If, however, the stimulants upset the digestive organs and sickness comes on, or the patient begins to refuse them, speedy prostration supervenes and rapidly terminates the life of the patient. Opium, or other narcotics, are often required in this affection, in order to allay nervous irritability and diminish pain. T. Pickering Pick.

CERUMEN. *See* Ear, External.

CERVIX UTERI, Amputation of the. This operation is generally performed either for the removal of malignant disease, or for the cure of the troublesome results which may follow hypertrophic elongation of the cervix. Operations for malignant disease must be conducted, in the case of the uterus, upon the same principles as in any other form of cancer or sarcoma; but in this special case the difficulty of removing the entire morbid growth is often peculiarly great, and the surgeon can seldom feel sure that he has done so. As anything like a free use of the knife or cautery in the neighbourhood of the uterus entails great risks, it follows that, if the cervix be amputated and there be the least suspicion that some of the disease is left behind, the use of scraping instruments or strong caustics will be rendered necessary, any further cutting operation being out of the question, unless total removal of the uterus be meditated. All these questions are dealt with in standard works on diseases of the uterus, to which the reader is referred.

Turning to the consideration of the operation alone, it must be borne in mind that the surgeon aims at removing just as much of the cervix as he desires—not too little, so as to nullify all premeditated benefits, and not too much, so as to involve several serious risks. He also presumes that the canal of the uterus will not be obstructed after the operation. It happens that even a very small experience shows how very hard it is to remove precisely as much of the cervix as is required. The position of the cervix prevents that free use of the hand and perfect control of the part to be cut through, which can be brought into play when a limb is amputated. Even the most skilful operators have met with very bad results when employing the knife or any kind of écraseur. The wire or chain not unfrequently drags down the posterior *cul-de-sac* of the vagina, and tears away a piece of peritoneum from Douglas's pouch. To avoid this disaster, which may be followed by severe hæmorrhage or peritonitis, some surgeons have been accustomed to free the uterine part of the cervix by cutting away the vaginal mucous membrane round its reflexion on to the cervix; but this proceeding is not to be recommended.

The least objectionable, most successful, and most generally recommended instrument for amputation of the cervix is undoubtedly the galvano-caustic wire. The patient being placed in the lithotomy position, and the vagina depressed by a Sims's speculum, the cervix is seized with a pair of vulsellum forceps, and drawn as low down as is needed, an assistant facilitating the process by pressing on the fundus uteri from above the pubes. The loop of platinum wire is then passed round the cervix as high up as is desired, and drawn tight. The next stage of the operation consists in the process of cutting through the cervix with the red-hot wire. If this be done in a hurry, the risk of hæmorrhage and of a slipping downwards of the wire, with consequent amputation of an insufficient portion of the cervix, will be very great. The advice given by Dr. Barnes should be followed. The wire being drawn so tight as to imbed itself in the groove which it forms in the tissues, it can then be made red-hot without any fear of its damaging the vagina. The loop must be made tighter as it burns through; time must be left after each tightening to allow it to get red-hot again, as the tissues must be burnt through, and on no account cut through by overtightening the knot. When the cervix is entirely burnt through, the stump must be cleaned by free syringing with ice-cold water; bleeding points may then be secured; and lastly, the vagina is plugged with lint soaked in some antiseptic solution. The cut surface will granulate and heal within a month. It is very necessary to pass a sound occasionally to avoid contraction of the uterine canal.

Alban Doran.

CERVIX UTERI, Stenosis of the. Authorities upon gynæcological questions are much divided in opinion as to the relation of dysmenorrhœa to organic stricture of the cervix uteri. Although stenosis of the cervix is intimately associated, in the minds of many, with painful menstruation, the relations of the two still lie within the domain of theory; and stenosis will, therefore, be here considered in its definite forms, ranging from a distinct contraction to absolute atresia. In all these forms there may be no symptoms of dysmenorrhœa throughout the course of the case.

Stenosis of the cervix may be congenital or acquired. The congenital variety is often associated with the small, tough, strongly anteflexed and ill-developed uterus seen in sterile women who have never menstruated, or whose catamenial show is scanty and attended with pain. As in such cases, little, if any, fluid escapes through the cervical canal; as the flow of that fluid is never sudden or rapid; and, lastly, as the fact of distension of the uterine cavity with retained fluid has not been proved in cases of stenosis, it is, at least, probable that the pain is due to causes other than obstruction. Acquired stenosis has been repeatedly observed as a result of partial amputation of the cervix, of injury during parturition, and, though to a limited extent, of inflammatory diseases and neoplasms in the canal. Putting aside the contraction of the canal, very common after the menopause, there can be no doubt that stenosis has been produced by the abuse of caustics or of scraping with the curette, and this fact has been frankly admitted by some of the advocates of these practices.

When, from any of the above causes, the cervical canal is found to be extremely narrow, resisting the withdrawal of the sound, stenosis of the cervix may be diagnosed. Difficulty in the introduction of that instrument, however great, is not satisfactory evidence; for, in cases of spasmodic dysmenorrhœa, the sound slips out with ease, though its entrance, aided by a considerable amount of force, may have taken several minutes. In such a case, there is generally severe pain as the sound passes through the os internum. In true stenosis, this pain is often absent. In a case of stenosis, menorrhagia may exist; in complete atresia this symptom is impossible. The diagnosis of a uterus distended by retained fluid may, it must be remembered, be very difficult. Circumstances may render it unadvisable to use the sound, and the swelling may be taken for pregnancy or a uterine tumour.

Should the surgeon be able to detect true stenosis, not amounting to atresia and accompanied by severe dysmenorrhœa, then, especially in an acquired case, he may dilate the cervix by bougies or tents, preferably the former. When atresia exists, the case will require very grave consideration. The distended uterus may be associated with dilatation of the tubes and its concomitant evils; and, again, operation may be followed by the disastrous results which have been known to occur after the puncture of an imperforate hymen. In such a case, it is advisable to draw down the cervix with a tenaculum forceps, after a Sims' or Neugebauer's speculum has been introduced into the vagina, and to puncture the obstruction very carefully with a very fine aspirating-needle. After aspiration, the best treatment is to keep the parts as aseptic as possible without active syringing. An iodoform pessary, of Ehrendorfer's composition, may be introduced into the vagina; it is an excellent means to this end, and sometimes takes three or four days to melt. The use of bougies will be required for after-treatment.

Alban Doran.

CHANCRE.—A chancre may be defined to be any primary sore connected with venereal disease. The association may be direct or indirect, and it is not necessary that the sore should be on the genitals. Neither is it necessary that a chancre should lead to syphilis. There are chancres which infect the system, and others which do not. All chancres are contagious, and are produced by contagion only. All chancres are liable to affect the lymphatic glands nearest to them, and thus to produce bubo. The characters of the bubo will usually resemble those of the chancre. If the latter is hard, well-defined, and not inflamed, the enlarged glands will be hard, loose, and almost free from inflammation, but if the chancre be inflamed and suppurating, the bubo will very probably suppurate also.

It is exceedingly difficult to determine correctly the relationship between infecting and non-infecting chancres. The difficulties are much increased by the circumstances that the characters of the two are often seen together in the same sore, and that the one is very often introductory to the other. We shall probably be near the truth if we believe, that non-infecting chancres are produced by the contagion of inflammatory secretions from venereal sores of all kinds, which do not contain at the moment the specific virus of syphilis; or in some cases it may be the fact that the recipient is not liable to the specific contagion, having been temporarily protected by a previous attack. In yet other cases, it may be that the acute inflammation induced by the pus-contagion makes the site of the chancre unfavourable for the development of the specific virus. The school of dualists believe that there are, and have always been, two wholly different kinds of virus, which have no relation to each other, but produce their effects side by side. There is no great difference of opinion as to the facts; it is simply as to their interpretation and the terms in which they are described. For the unicist, the non-infecting sores are usually an appanage of syphilis; for the dualist they are wholly distinct. Both will admit that the contagion of non-venereal pus—from boils, for instance—may produce, when inoculated on the genitals, ulcers, which may have a certain duration, and may simulate the non-infecting sore; but both will also probably assert that the venereal non-infecting sore usually presents peculiarities. The diagnosis between the chancre which will infect the system, and the one which proves to be a local ulcer only, is often exceedingly difficult. In many cases, if a month or five weeks have elapsed since the contagion, it is often—indeed, usually—quite easy to decide, but in a few it may be impossible.

The feature which is of chief importance in the decision is the very peculiar kind of hardness which the sore often assumes. In well-marked cases this induration may be such as might be produced by a disc of cartilage. It causes the affected portion of mucous tissue, if it be in the roll of the everted prepuce (its most common site), to stand up in a sort of collar, and it is not necessary to use the finger to recognise the induration. When in other parts, as the skin of the penis, or elsewhere, it produces, not a collar, but a round patch or button, which is usually well circumscribed and but little inflamed. The sclerosis of tissues and the absence of common inflammatory action are the chief features. Sometimes the sore will not show any ulceration from first to last, and it is very common for the ulceration to heal and leave the induration still present. The size and thickness of the hardened patch may vary very much. The disc may be no bigger than half a pea or as large as a half-crown. Whilst the absence of inflammation and the presence of induration are the common features, it is yet quite possible that the sore may deviate very widely from rule in either direction. It may be acutely inflamed, and it may be wholly without hardness. These deviations probably depend chiefly on the peculiarities of the recipient, but they may also in some cases be due to the nature of the secretion in which the virus was conveyed. If the pus-secretion be of an irritating character, the inflammation caused may obscure the features of the specific induration. Thus chancres produced experimentally, and with secretions as little mixed as can be helped, run, usually, a more typical course than those which occur *au naturel.* In some cases the inflammation of a chancre becomes erosive, and assumes the features known as phagedæna. This process may entirely destroy the chancre and extend widely in the parts around. It seldom, however, occurs early enough to prevent the infection of the system.

Next in importance to the two conditions named, we have, as distinctive of the infecting or true chancre, its observance of stages. It has been well determined by experiments that, between the date of contagion and the full development of induration, a period of nearly five weeks will intervene. Observations on patients, when the infection has been accidental, are in accord with this. The first result of contagion is usually a little red point, which lasts only a few days and then wholly vanishes. During the fifth week the site of this point usually becomes irritable and again red, and very quickly develops slight hardness. Upon this hardness ulceration takes place, but, the induration continuing to widen, is still of much greater size than the ulcer. The ulcer usually secretes very sparingly, as has been already said. At the end of the sixth week the induration may be expected to be at its height, but in many cases it is very short-lived indeed, and may disappear in a few days, and the sore heal and be forgotten.

There is no fact more certain in medicine than that mercury can cause the sclerosis of a true chancre to disappear, and that it invariably does so in the most remarkable manner. We seldom see a chancre run its course without interference from this specific. If, however, the very largest indurations be left to themselves, there is reason to believe that they will not, as a rule, last long. The normal duration is, however, varied. They may, as first said, vanish before full development, or they may persist for many months. If mercury be prematurely interrupted, the chancre will indurate again, and in rare cases we encounter what are called 'relapsing chancres' in which the hardness returns over and over again in the exact site of the chancre, during several years. The periods specified are usually observed with great exactness in all cases of experimental chancres, and in all those which occur in vaccination. It is probable that the observations which assert that definite induration may develop in much shorter periods, or that its first occurrence may be delayed to much longer ones, are founded on error.

When the chancre has been produced by sexual contagion, the secretion causing the infection will almost always be mixed—that is, it will contain pus-elements, the products of inflammation, as well as the specific virus. From this it results that very often a pus sore is produced at once, or within a few days after the exposure. This sore may persist during the whole month which intervenes before induration sets in. In such cases a sore, which has had the characters of a non-infecting one during the first month or five weeks, finally develops those of the syphilitic kind and is followed by the usual results. Such a chancre may continue to suppurate after induration of its base has occurred, and may thus present 'mixed' features.

Another character which usually denotes an infecting sore is that it is single; or rather, perhaps, it should be said that the non-infecting are often multiple. The infecting sore is not always single, for there may be two, three, or more. If multiple, we may be sure that they all result from contagion at one and the same time, for it is impossible for a true chancre to produce others in the same person.

The characters assumed by chancres which do not prove infecting are very various. The sore is, however, invariably developed within a few days—it may be a few hours—of the exposure to contagion. As a rule only one sore is present at first, but there may be two or three. As a result of contagion from the pus secreted by the first sore, others may be produced, usually in its close proximity. If the part on which the sore has appeared is in apposition with another surface, this latter is almost always infected. The degree of inflammation, ulceration, &c., may vary very much. Many sores of this kind heal within a week of their formation, and never assume any peculiarities. In other cases the sores last long, have abrupt cut edges as if punched out, and show a grey surface destitute of granulations. Although they often spread at their edges to some slight extent, and closely approach the condition known as phagedæna, yet they very rarely pass into it. Phagedæna may, however, supervene, especially if the prepuce be phimosed, and the secretions pent up. With these sores there is almost invariably early enlargement of the glands in the groin. The bubo is often inflamed and the glands become matted together in one lump. There is much risk of suppuration, and large and troublesome abscesses may result. *See* BUBO. The nearer the sore to the frænum, the more certain it is that bubo will occur.

The infecting chancre may be met with on any part of the body, and has been recognised on the scalp, on the face, in the palm of the hand, and sole of the foot, on the lips, tongue, and tonsils. It is now and then multiple on the surface of the body, as, for instance, in policemen and others who have been bitten and scratched by prisoners suffering from syphilis. The non-infecting chancre, on the other hand, has never been recognised as such on other parts than the genitals. This, however, may result simply from the fact that its features are ill-marked, and we have no proof of its nature to which to appeal. Probably, also, on any other part than under the foreskin a non-infecting sore would usually soon heal. Its production and its perpetuation seem both of them to be closely connected with retention of irritating secretions.

As regards the relative proportion of infecting and non-infecting chancres, it is difficult, if not impossible, to collect trustworthy statistics. A great number of those diagnosed as non-infecting at first, assume other features at a later stage. No observer has a right to put down a sore as non-infecting, unless he has watched the case during a long period and made sure that the sore never changed its character, and that nothing followed it. It is unsafe to rely upon any local characters or their absence. If we make allowance for errors of diagnosis, and also for a not inconsiderable number in which the sores are so trivial and of such short duration that it may be doubted whether they are specific at all, it will be found that a very large majority of venereal sores are infecting. This applies, of course, chiefly to those who contract sores for the first time. A certain number of so-called 'soft sores' are such because they occur in those who, having had the disease before, are not susceptible of syphilis.

The *treatment* of chancres has been much simplified of late years. In all stages and conditions attended with suppuration and without definite hardness, iodoform is to be applied, and it will cure quickly in four cases out of five. It may be used as a powder, dusted into the sore, and, when healing commences, as an ointment, in the proportion of a drachm to an ounce of vaseline. The sores which resist iodoform usually have more or less tendency to phagedæna, and often prove for a time very difficult of cure. Iodoform is, in the first instance, to have a fair trial, the free use of warm water being also enjoined. If the sore do not heal, black-wash may be tried, or, if it assume an unhealthy aspect, the acid nitrate of mercury may be applied as a caustic. There are sores, however, which will resist all these measures, and which become healthy only when mercury is given internally. When positive phagedæna supervenes it may be necessary, in addition to the measures just mentioned, to keep the patient in a hip-bath of warm water continuously for a period of several days. *See* PHAGEDÆNA.

If a chancre show specific hardness, it is advisable at once to begin the administration of mercury, and thus anticipate and usually prevent secondary symptoms. All non-secreting indurated sores should be dressed with black-wash in preference to iodoform.

The question of the abortive treatment of chancres does not often come within the domain of practical surgery. For the most part our patients consult us too late. Some facts appear to show that the poison is imbibed early, and it avails little to excise or destroy a chancre within even so short a period as four or five days. These facts ought not, however, to hinder us from giving the patient such chance of escape as excision affords in all suitable cases. Paquelin's cautery is the best instrument to use, and with it either the sore may be burnt up in the freest possible manner, or—what is still better—a liberal excision of the structures around the infected spot may be made. Any chancre coming under the observation of the surgeon within a week of contagion, and on a part where such treatment is practicable, ought to be so dealt with. JONATHAN HUTCHINSON.

CHARBON. *See* MALIGNANT PUSTULE.

CHARCOT'S DISEASE.—*Synonyms:* Arthropathy of ataxia; neurarthritis in connection with tabes dorsalis or progressive locomotor ataxy (Duchenne's disease). A peculiar form of arthritis, usually affecting large joints, especially the shoulder, elbow, knee, and ankle, arising in the course of the disease known as locomotor ataxia. This was first discovered and described by M. Charcot in 1868.

Cause.—The disorder is only met with in a marked form in cases of spinal tabes, and must, therefore, be regarded as directly dependent either on definite lesion of the cord, or as a part of the whole morbid state of which that sclerosing lesion forms the main or most obvious change. It is not very common, but since attention has been directed to the disorder, many cases have been brought forward in France, America, and in this country.

Pathology.—The exact nosological position of this malady is not yet determined. There is hardly any difference of opinion as to the fact that this peculiar arthritis forms part of the disorder recognised as tabes dorsalis, although some surgeons, who commonly see these cases in the first instance, are unable to detect any specific difference between them and certain cases of chronic rheumatic arthritis. It seems probable that some cases hitherto believed to be examples of hydrarthrosis have really been instances of Charcot's disease, in which the tabetic spinal symptoms were either little marked or overlooked. It must be allowed that many of the changes occurring in the affected joints are common to both morbid states. This being so, the writer holds strongly to the opinion that these changes in and by themselves, tell no complete or accurate story as to the clinical features which previously characterised the particular instance under examination. This disorder has been considered to be a new manifestation of joint-disease, chiefly for the reason that, till within recent years, no examples of its morbid anatomy have been collected and preserved in museums. The same might fairly have been affirmed of tabes dorsalis itself, and of other maladies also, till Romberg and Duchenne, by their investigations, led to its differentiation. The writer prefers to believe that it is not a new disease, but has simply been unrecognised as a specific form of neurarthritis, and that, probably, specimens illustrating it are already in museums, arranged as examples of chronic rheumatic arthritis.

Certain articular troubles have long been recognised as dependent on disease of the brain, cord, and nerves. Thus, effusion and inflammation in joints, with ankylosis, changes in the skin, œdema, &c., are regarded as sequential trophic alterations in relation to various paralyses and traumatic affections in the line of nerve-supply to the joints and affected parts. These trophic changes are attributed to damaged nerve-centres, and many of these are now known to be situated in the grey matter of the spinal cord, as, for instance, those presiding over the nutrition of muscles being placed in the anterior horns. The special centre, or centres, for the joints, if there be such, are not yet determined. The fact that in progressive locomotor ataxia the line of morbid action follows the postero-external columns (Burdach's), without, as a rule, implicating the anterior columns or grey matter, seems to militate against the view that, in this disease, the joint-affection, when it occurs, can be due to an affection of the latter. Moreover, the sclerosis may spread to other tracts of the cord, and even involve the anterior horns without inducing the specific articular affection. Some authorities, notably Buzzard, consider that a trophic centre for the joints is situated in the medulla oblongata, and some proof of this is gathered from the fact that troubles of the vagus are commonly associated, in cases of ataxia, with Charcot's joint-disease.

In most instances the affection occurs early in the course of spinal tabes, at a period between the prodromal and the ataxic symptoms. The disease may also supervene at a later stage, and is then almost constantly found in a joint of the upper limb. In relation to (1) an early and (2) a later form, it may be noted that the part of the cord affected is not always in the same region; thus, the sclerosis may begin in the higher centres, as in the medulla, and come later to affect the dorsal or lumbar portions, and *vice versâ.* Further, it is necessary to point out that tabetic patients may, like other persons, be the subject of chronic rheumatic arthritis, which runs its course as usual, presenting no special features of Charcot's disease. It has already been noted that in many of the cases examined *post mortem* all the changes recognised as the result of chronic rheumatic arthritis have been met with, and while this has been the case sometimes in certain joints, others in the same patient have presented the characters more particularly attributed to Charcot's disease. Thus, ulceration of cartilage, marginal overgrowth, dendritic, synovial, and bony growths, erosion of bone, and eburnation are found in one joint; and the results of riotous disorganisation, with fracture of bone and extreme absorption of epiphyses, are discovered in another. Hence, if morbid anatomy could testify to the pathogenic process which has been at work, there might be a fair inference as to identity in pathology of these conditions. The clinical features of the malady, however, forbid the acceptance of this view, and the furthest point of speculation here admissible, for the present, is to regard both the specific arthropathy of Charcot, and chronic rheumatic arthritis, as forms of neurarthritis.

It has been stated that no attempts at repair are seen in affected joints. This is not the case. The existence of osteophytes and of eburnation suffices to disprove this. Marginal hyperplasia is common. This is not peculiar to any form of arthritis, and is found both in gouty and rheumatic joints. Without question, the most characteristic features of Charcot's disease are the sudden onset, the extreme effusion, the rapidity of the whole process, the rapid wasting and wearing down of the bones with consequent tendency to fracture. The cases in which the disorder is of slower onset more closely resemble rheumatic arthritis. The 'benign' examples are unlike the latter in that a greater tendency exists to complete recovery from the primary local lesion which, unhappily, is too rarely witnessed in rheumatic cases.

It is important to note that other evidence of trophic disturbance sometimes occurs in the progress of tabes dorsalis. Thus, perforating ulcer of the foot is apt to occur in a small proportion of cases. Attention has also been directed to a form of arthritis involving the tarsus, sometimes with and sometimes without associated arthropathy elsewhere. To this form M. Charcot has applied the term *pied tabétique.* Disorganisation of the tarsal joints and destruction of the arch of the foot occur, certain bones may become ankylosed, and others so broken down as to be hardly recognisable, while many fragments may be found detached from them.

The relation, if there be any, between this disease and chronic rheumatic arthritis is not, at present, readily determined. An 'error of nervous force,' it has been suggested, may determine the lesion, but the method and manner of it are dependent on other causes, such as rheumatic, gouty, or syphilitic tendencies (Paget). In the writer's opinion, the phenomena of this disease throw light upon those of chronic rheumatic arthritis, the neurotic origin of which he is disposed to believe in. The life-history is essential to the determination of the nature of the morbid process in each case. In this disease the joint-changes may be the direct result of central (spinal) irritation; in rheumatic disease, there may be reflex dystrophies. The influence of the nervous system here is thought by some to be merely passive, and the changes but a result of injury inflicted upon parts whose sensibility is impaired. *See* CHRONIC RHEUMATIC ARTHRITIS.

An important point is raised by the existence of certain cases of locomotor ataxy in which no central (spinal) lesions are found, but changes are confined to the peripheral nerves. It may be that future investigations will throw light upon the latter, and that such may be found both in cases of this special arthropathy and in those of chronic rheumatic arthritis, illustrating the trophic changes in each instance. It is conceivable that, with central spinal disease, the arthritic degenerations may proceed in different fashion from that commonly occurring where no coarse lesions are present in the cord. Certainly, it is found that the affected joints can be used without pain or great inconvenience in some instances. There have been no constant lesions found in the cord or peripheral nerves in these cases. The rule is to find the ordinary affection of the columns of Burdach, but atrophy and destruction of ganglion cells have been found in the anterior cornua and in the postero-lateral groups. In unilateral cases the changes have been found limited to the corresponding side of the cord; in the cervical region when the shoulder has been affected, and in the lumbar region when the knee was involved. Inflammatory changes—whether primary or secondary is not known—have also been observed in the peripheral nerves in cases of tropho-neurosis associated with locomotor ataxia. The most recent hypothesis on the whole subject has been put forward by Morrant Baker, who conceives that there may be a pathological connection between this special arthropathy, tabes dorsalis, and chronic rheumatic arthritis. He thinks that all these disorders may arise from 'some antecedent morbid state of which the result is expressed in pathological changes, sometimes in the cerebro-spinal system, sometimes in the joints, and sometimes in both.'

Symptoms.—Sudden and painless swelling in a joint, without any local premonitory symptoms, is significant of this disorder. The patient may present no sign of incoordination, but commonly has suffered from 'lightning' pains in the limbs. Pyrexia is absent. The knee is most often affected, then the shoulder, elbow, hip, and wrists, in order of frequency. The small joints are not exempted. The swelling is more or less firm, due to effusion into the synovial cavity. The integuments are not reddened, and there may, or may not, be local œdema. Some crackling may be noted at times before the extreme effusion. The '*benignant*' *variety* is characterised by subsidence of the swelling and return to a natural state after some weeks or months. The '*ma-*

lignant' variety leads on to rapidly degrading changes, rupture of ligaments, dislocation, fracture, and impaction of fragments of bones—a 'riotous' arthritis, in short; and all this may be set up in a few weeks. In spite of these profound changes the limb affected may retain a remarkable amount of power, movements may be freely executed and work carried on without any suffering. Portions of bone may become detached and adhere to the capsule of the joint, or osteophytes may form, and abundant dendritic outgrowths of cartilage or bone may occur within the joint. Spontaneous fracture may occur in sundry bones in some cases. The early tumefaction is not always sudden. Patients with gravely affected joints may live for many years, and retain remarkable powers of motion and capability. Thus, one man (under the writer's care) worked as a cooper's labourer for six years with hydrarthrosis and flail-like movements in both elbows, suffering no pain and little inconvenience, ataxic symptoms being well-marked at the end of that time.

The following table shows the prominent characteristics of Charcot's disease and chronic rheumatic arthritis in well-marked cases :—

Charcot's Disease.	*Chronic Rheumatic Arthritis.*
Patient not necessarily of rheumatic habit.	Patient of rheumatic habit.
Onset sudden, independent of injury, but not invariably so.	Onset gradual; often determined by injury.
First symptom : extreme tumefaction, rarely crackling.	First symptoms : slight swelling and crackling (extreme tumefaction rare and, perhaps, never sudden).
Pain absent; knee-jerks absent.	Pain severe; knee-jerks present.
Dislocation common.	Dislocation rare.
Progress : may retrograde, or disorder pass off.	Progress constant, often permanent.
Bones apt to wear away; osteophytes less marked than in rheumatism ?	Much production of new bone and osteophytes.
Fragility of bones.	Condensation of bones.
Ocular symptoms.	No ocular symptoms.

It is true that instances of this disease have been noted in which it has not been possible to draw the hard and fast lines indicated above, but enough remains to show that very specific characters pertain, for the most part, to the form of arthritis which occurs only, so far as is known, in that variety of spinal tabes which induces the symptoms of locomotor ataxia. The bones are apt to become porous and fragile.

These cases have been commonly seen in the first instance by surgeons, and, hence, the special nervous symptoms associated with them, unless present in marked degree, have been apt to be overlooked. More instances have been found since the attention of surgeons has been directed to them, and, in future, it will be well to look for tabetic symptoms in all cases of monarthritis involving the larger joints. The fact that locomotor ataxia has only been clearly differentiated of late years no doubt accounts for the absence of mention of these cases by earlier writers. It is certain that the arthropathy may occur independently, or before, any active symptoms of locomotor ataxy.

Diagnosis.—This is to be made by consideration of all the concomitant nervous symptoms which may be present. These are not far to seek in most cases. The joints may be affected early, and but few indications of ataxia be found; but these are apt to supervene. The disorder is most likely to be mistaken for chronic rheumatic arthritis, and a careful review of all the symptoms, the history, the question of heredity, with knowledge of the special features of this arthropathy, will commonly avail to render the diagnosis certain. Malignant disease may be suspected in cases where the progress is rapid in an instance of monarthropathy. These disorders will be found free from the severe pain, local and reflex, and the muscular spasm which commonly accompany other forms of acute arthritis.

Treatment.—The affected joints must be set at rest. Cotton-wool, covered with light and well-adjusted bandages, should be applied. Strips of buckskin, covered with mercurial and ammoniacum plaster, and carefully applied, are useful for hydrarthrosis in any stage. Splints will be necessary in some cases to secure immobility, and casings of leather, with suitable straps, will be proper to support and restrain joints whose movements, owing to suppleness and dislocation, are too free. Remedies for the central nervous lesion must be employed, as in ordinary cases of locomotor ataxia, benefit being sometimes secured by nitrate of silver, iodide of potassium, mercury, and by cod-liver oil. Monobromide of camphor in full doses is of value for 'lightning' pains and insomnia. The disorder may altogether subside in benign cases. In the others the prognosis is bad, and the local troubles become of secondary importance as other symptoms of the constitutional malady progress. DYCE DUCKWORTH.

CHEEK, Fissure of the.—Syn.: *Macrostoma congenitum.*—This very rare deformity consists of a unilateral fissure extending from the corner of the mouth proper for some distance into the cheek, and usually continued as far as the anterior margin of the buccinator, but occasionally running upwards toward the outer angle of the orbit. The natural point of junction of the two lips is marked on each by a slight papillary elevation of the mucous membrane; but with that exception there is no difference in the condition of the parts forming the cleft from that of the lips, the inner surface being lined with a similar mucous membrane which joins the skin of the cheek, just as that which forms the red surface of the labium. The deformity is very unsightly, and gives the appearance on one side of the face of a very elongated mouth, whilst the non-union of the fibres of the orbicularis oris causes a want of expression, which is more marked when any attempt is made to smile or laugh. This unsightliness is, in many cases, increased by the presence of so-called auricular appendages or supernumerary auricles, which, however, are not always present. When they occur they are placed in front of the tragus or upon the cheek itself, in a line between the end of the fissure and the tragus of the ear, and they consist of fleshy elevations, generally containing cartilage, and covered with soft hairy skin similar to that over the helix. In shape they are small, oval, and sometimes as large as a horsebean, and are attached by a pedicle to healthy skin of the cheek, or the base of attachment may sometimes be as broad as the growth itself. They are usually bilateral, though not necessarily symmetrical in shape, or position, or number. The external ear is generally more or less misshapen on one or on both sides, and the external auditory meatus may be absent.

Causes.—The deformity is congenital, and results from a failure of union between that upper part of the first visceral arch from which is developed the superior maxilla, and the lower part of the same arch, from which Meckel's cartilage is derived, and upon which the lower jaw is formed. As the first visceral arch is visible in the human embryo at the third week, and is the earliest to unite with its fellow of the opposite side, this deformity may be regarded as a pure accident of development; and since it is found in children with elder brothers and sisters who are perfectly formed, and where no trace of similar deformity has occurred in the families of either parent, it is not hereditary, and, from the early period of pregnancy at which it must take place, maternal impressions are not likely to influence its origin.

Symptoms. — The appearances above described are unmistakeable (for portrait see paper by the writer in *Medico-Chir. Trans.*, vol. lxv. p. 20). It occurs more permanently in girls than in boys, and the subjects are often delicate. The lower jaw is frequently small and ill-developed, especially upon the side upon which the fissure exists. Besides the supernumerary auricles there are sometimes to be seen upon the cheeks of these patients small cicatrix-like striæ, or pore-like openings, ending in a *cul-de-sac.*

Treatment.—Since the condition does not cause any impediment to the power of sucking, there is no necessity to operate at a very early age, and it is wiser to allow the first year of life to pass, so that the child may be weaned and be brought into a better condition to bear the slight loss of blood incident to the operation. The child having been anæsthetised, all that is required is to make a clean incision extending just beyond the mucous surface of each lip, and to bring the cut surfaces together with two or three silver sutures, which should pass completely through the substance of the cheek and out again before being twisted together. This is preferable to the use of harelip pins, as being less likely to cause cicatrices. One stitch should be placed at the point where the two lips should naturally join, and another half-way between it and the angle of the cleft, whilst if necessary the edges of the skin may be more neatly adapted by fine sutures of horsehair or catgut. The sutures may be left for three or four days before being removed; and the wound should be dusted with a little iodoform powder, or painted with collodion to which iodoform has been added, and must be covered with a pad of lint, which should be firmly retained by strapping, so arranged as to prevent, as far as possible, any movement of the facial muscles. Every effort must be made to obtain primary union of the wound, and if this is successful the result will be found extremely satisfactory.

John H. Morgan.

CHEILOPLASTY.—Under this heading is included a great number of operative procedures of an autoplastic character, performed either for establishing an oral aperture of normal size and shape in cases of congenital malformation, or for the reconstruction of a lip that has been destroyed, to a greater or less extent, by the surgical removal of a new-growth, by malignant or syphilitic ulceration, or by the primary or secondary and cicatricial results of injury. It is proposed to deal in this article only with the latter classes of cases, as the operations necessary in cases of congenital malformation will be described under HARE-LIP; CHEEK, Fissure of the.

The main object in a cheiloplastic operation is, whilst preserving a shapely and efficient oral aperture, to protect the teeth and gums, by one or more transplanted flaps of sound and healthy structures taken from the immediate neighbourhood of the defect. It is also a very important point to preserve, if possible, a free margin of mucous membrane. In most of the procedures that have been devised, each flap, after its dissection, is glided into its new position, and is not twisted. In his selection of one out of the very numerous and varied methods of cheiloplasty, the surgeon will be guided by the extent of the defect and the condition of the surrounding parts. Endeavour should be made so to contrive the dissection of the flaps that the resulting cicatrisation and retraction of the fresh wounds may tend rather to keep the flaps in their new position than to drag them away.

The simplest of cheiloplastic operations on the *lower lip* is that in which the edges of a V-shaped wound, formed by removal of a small tumour or ulcer, are immediately brought into contact by harelip pins or wire sutures.

The following are some of the best known of the very numerous operations that have been performed in cases of considerable destruction of the lower lip:—

In *Chopart's operation*, performed for covering a large rectangular defect after removal of extensive disease of the lip, a rectangular flap with its base below is taken from the chin and front of the neck, and drawn upwards over the lower jaw towards the mouth. The lateral margins of this flap are attached by sutures to the lateral margins of the primary wound, and its upper free margin forms the lower boundary of the oral aperture. This procedure is attended with several disadvantages, and its results in general have not been very satisfactory. There must be considerable tension of the flap, and it is necessary for the patient to keep the head bent forwards during the after-treatment. The flap may be dragged downwards even before the removal of the sutures. Its free labial margin, being formed of cicatricial tissue, is often very thin and uneven, and may be rolled inwards by retraction. The principle of this operation, however—that of taking the sound skin from the chin or front of the neck—has been followed, with modifications, by many surgeons, of whom may be named Lisfranc, Roux of St. Maximin, Zeis, and v. Langenbeck. Serres, of Montpellier, who was the first to propose saving the mucous membrane of the lower lip, in order to replace it on the free margin of the flap, has devised a method of inferior cheiloplasty, which, in a modified form, has been recommended by Mr. Erichsen. The object of this modified operation is, it is stated, to raise the lower lip to a level with the incisor teeth. 'An incision about three-quarters of an inch in length is made directly outwards from the angle of the mouth, on each side, into the cheek; from the extremity of this, a cut is carried obliquely downwards on to the upper margin of the lower lip so as to excise the included triangular piece; the lower lip is then dissected away from the jaw, and a V-shaped piece is taken out of its centre. By means of a harelip pin, and a point of suture on each side, the incisions in the angles of the mouth are brought accurately together; and, in the same way, the vertical one in the centre is united. If, on the removal of the diseased portion of the lip the mucous membrane has been left rather long, a good prolabium may be formed, and the restoration effected with but little deformity.' (Erichsen.)

Although a large and vascular flap may in most instances be readily obtained from the front of the neck, the tendency to retraction and sinking of this flap, and the accumulation of blood and wound-secretion in the large pouch formed below the seat of operation, render most modifications of Chopart's method less advantageous than those in which the defect is covered by lateral flaps taken from the sides of the face and brought together in the middle line. Procedures of this kind, however, can, as a rule, only be applied to cases in which the integument of the chin remains in a sound condition.

In *Syme's operation* for restoration of the lower lip, the principle of which is to leave the central part of the chin undisturbed, and to cover the defect by two lateral flaps, two incisions are made from the centre of the gap outwards and downwards to the extent of rather more than an inch, and are then carried outwards and downwards and at last a little upwards, so as to terminate on each side below the angle of the jaw. These flaps are then raised so that the two straight portions, formed in the first instance, meet together in the middle line and are united by silver sutures. The remaining extent of cut edges are united to the edges of the Λ-shaped portion of skin over the chin, which serves to support and prevent downward gliding of the flaps which form the new lip.

Buchanan's operation is applicable in cases of extensive malignant disease affecting the upper part of the lip, and leaving the chin quite free. From the centre of the inferior curved margin of the wound, made on removing the disease, two straight incisions, one on each side of the median line, are carried downwards and a little outwards. From the lower end of each of these incisions a long and but slightly curved incision is made in a direction outwards and upwards. The two oblong flaps thus mapped out are dissected from the subjacent parts and then raised upwards, the upper curved margins forming the margin of the lip, and the short inner margins of its flaps coming into contact in the median line, where they are connected by sutures. The triangular wound left below each flap is allowed to heal by granulation.

In *Teale's operation* for severe cicatricial deformity of the lower lip from burn, the everted lip is divided into three parts by two vertical incisions, each three-quarters of an inch in length. The width of the middle portion found between these two incisions should equal half the width of the lip. From the lower extremity of each of the vertical incisions, a curved incision is next to be carried upwards and outwards to a point about one inch from the commissure of the lips. The two lateral flaps are then dissected up, and raised and united by sutures in the middle line above the middle flap, to the freshened upper margin of which their lower margins are also fixed by sutures.

Other operative procedures for the reconstruction of the lower lip by the formation and apposition of lateral flaps, have been devised by Malgaigne, Dieffenbach, Bruns, and Szymanowski.

In a case of very extensive destruction of the lower lip, and of the soft parts of the chin, it might be possible to perform a satisfactory cheiloplastic operation by applying Reid's method, taking, in the first place, a single flap from the skin of the neck, and subsequently bringing together, above this, two lateral flaps.

Cheiloplastic operations on the *upper lip*, performed mostly in cases either of congenital malformation or cicatricial deformity, consist in varied applications of the double lateral flap method. In *Bérard's operation* each flap is formed by one incision, carried from the upper extremity of the defect outwards through the soft parts of the cheek, and a second, parallel to this, commencing at the corresponding angle of the mouth. This procedure has been modified by Bruns, who, at the outer end of each upper incision, excised a triangular piece of skin with the apex upwards, and at the end of each lower incision a similar piece of skin with the apex downwards. Dieffenbach formed his lateral flaps by a curved incision on each side round the ala of the nose. Teale also performed a cheiloplastic operation on the upper lip by making two crucial incisions, the intersecting point of which was placed in the median line, just below the septum nasi. The two lateral triangular flaps thus formed were drawn inwards, one below the other, and retained in this position by twisted sutures. Other plans of superior cheiloplasty, on the same principle of lateral flaps, have been devised by Malgaigne, Mirault, and Sédillot.

W. Johnson Smith.

CHELOID. *See* Cicatrices, Pathological Conditions of.

CHEMOSIS. *See* Conjunctiva, Diseases of the.

CHEST, Deformities of the. *See* Caries of the Spine; Pigeon-breast.

CHEST, Injuries of the.—*General Diagnosis of.*—These injuries may be divided into:—(1) those presenting some external wound; (2) those without external wound.

1. This class may be again subdivided into wounds of the parietes alone, and penetrating wounds which affect the structures within the walls of the chest also.

The diagnosis of wounds of the external parietes alone will be mostly negative. The external wound may pass in a direction in which it is impossible that the chest contents should have been injured; and again there will be a total absence of the severer symptoms usually associated with injury to the contained viscera. The worst symptoms which such a wound presents are due to division of large parietal blood-vessels or nerves, or injury to muscle. Thus we may have a blood-tumour form beneath the integument or the muscle, as the immediate result of the wound; or, later on, suppuration may take place in the track of the injury, either under the muscles or directly beneath the skin and fascia.

When the structures within the thorax have been injured, the symptoms will be of a severer character. The pleura may fill up more or less with blood, forming a HÆMOTHORAX. Or air may enter its cavity, either from the external wound or from the wounded lung, forming a PNEUMOTHORAX. Or, finally, suppuration may take place in the cavity, constituting an EMPYEMA.

If the lung itself be wounded there will be effusion of blood into its substance, followed by inflammation, which may spread extensively, so that a very considerable part of the wounded lung may pass into a state of acute PNEUMONIA. This state is indicated at first by the expectoration of florid blood (hæmoptysis), and afterwards by the signs of consolidation of the lung, as shown by dulness on percussion, by rust-coloured expectoration, bronchial breathing and bronchophony; these latter signs may be much concealed by blood or fluid in the pleura in those cases in which there is much present. In either case, the burden of respiration will be thrown principally upon the uninjured lung, and there will be great dyspnœa and impeded circulation, as may be evidenced by blueness of the face, lips, &c. Percussion will give a dull note over the injured side (except in cases of pneumothorax), and auscultation will show the absence of efficient breathing. The temperature at first is somewhat depressed from shock, but later on may become elevated, especially if suppuration sets in. The diagnosis may be somewhat aided by the direction of the wound. In these cases it is not wise to permit much probing, but the direction of a wound can often be ascertained by collateral circumstances; and if these are absent, light and careful probing, not prolonged, will often sufficiently indicate the general direction of the wound, and show that some of the internal structures must have been damaged.

If the HEART or PERICARDIUM be wounded (and the one rarely occurs without the other), the symptoms are of the gravest character. Immediate death not infrequently follows, and, in those cases in which life is prolonged, recovery comparatively seldom takes place. Should life be prolonged, however, the signs of such an injury will consist in trouble to the circulation, from the impeded heart's action, a quick, small, laboured, and intermitting pulse, dyspnœa, and blueness of the face and extremities. The wound itself is attended by a sharp burst of hæmorrhage, which, however, speedily ceases as the external aperture becomes closed. The bleeding then takes place into the cavity of the pericardium, giving rise to the impeded circulation spoken of above, or into one of the mediastinal spaces, the signs of which are much more obscure. Auscultation of the heart does not give so much assistance as might be expected, but the precordial dulness is often increased. The heart-sounds are inaudible or scarcely audible, from the blood in the pericardium obscuring their distinctness, or if the amount of blood be very small, as in those rare cases where the pericardium is alone wounded and the heart has escaped, the friction-sound of pericarditis may be audible.

Penetrating wounds belonging to this class are sometimes complicated by foreign material, carried into the interior by the agent inflicting the injury. This is palpably the case in gunshot wounds, where a bullet is left in the chest. The same lesion exists when a portion of clothing is carried into the wound by a bullet, or, less frequently, by a stab. The diagnosis of this state will always be made with great difficulty, unless the foreign material can be seen or felt, though its presence will militate immensely against the chance of the patient's recovery. Not less dangerous, though much less palpable, is the foreign material carried in from without by a dirty weapon. This not infrequently gives rise to a poisoned wound, leading to the death of the patient from septicæmia.

2. The injuries to the chest without external wound comprehend fractured ribs, sternum, &c., and lacerations of the muscles, and also those cases in which the thoracic viscera have been damaged, either by compression from the injury or by a fractured end of bone having been driven into them. These cases will be treated of in separate articles, but it may suffice to state here that the general symptoms are similar to those in Class 1. When, however, the LUNG is injured, general EMPHYSEMA is often superadded to the symptoms before enumerated, but PNEUMOTHORAX is of less frequency, the air escaping directly into the general cellular tissue more often than into the cavity of the pleura. The diagnosis of this state is at once made by the swollen puffy state of the integuments, and by the crackling sensation communicated to the fingers on pressing them over the swollen part; this crepitant feeling is due to the air being squeezed from one part of the areolar tissue to another.

When the pericardium is wounded by the fractured end of a rib or of the sternum, the heart more frequently escapes injury than where there is an external wound. This injury is therefore of a less severe character, and may be recognised by the increased precordial dulness arising from the cavity of the pericardium being dilated with inflammatory effusion, or by the friction-sound which indicates the existence of pericarditis. H. G. Howse.

CHIGOE.—The parasite (*Pulex penetrans*, or sandflea) which causes this disease is one of the pests of the West Indies and some parts of S. America. While both male and female live in the sand, it is the latter which, when impregnated, makes its way under the nails or between the toes of the human foot, where its presence is made known by the appearance of a white pea-like vesicle, which leads to much itching and irritation.

Treatment.—The orifice of entrance is to be carefully found, and skilfully dilated with a needle, and the vesicle then turned out whole. Great care must be taken not to rupture the vesicle, otherwise the escape of the ova into the soft parts will lead to most troublesome suppuration.

W. H. A. Jacobson.

CHILBLAINS are localised erythematous congestions, usually met with on the toes and fingers of weakly subjects, and liable to inflammation and even ulceration from time to time. The patients affected are usually children, more frequently girls, who take insufficient exercise and who are allowed to hang much over the fire before going out, or return to it immediately on coming in. It is rare to meet with chilblains after adolescence, though occasionally they are seen in grown-up women. The usual sites are the feet, hands, and not uncommonly, to a lesser degree, the ears, or much more rarely, the nose.

Chilblains will be met with in the following conditions: (*a*) red swollen patches liable to congestion, especially after going to the fire, taking food, or when first taking exercise; and when congested, itching, pricking, or tingling most intensely. (*b*) After frequent attacks of congestion the chilblains become more swollen, tender, and covered with vesicles. (*c*) The vesicles break and leave raw excoriated surfaces, liable to pass into very troublesome ulcers. It is rare to see chilblains go beyond this third stage, though occasionally the ulcers they cause become sloughy or even gangrenous.

Treatment.—In the treatment of chilblains the chief aim of the practitioner must be to stimulate the weakly circulation both locally and generally. To begin with, tight garters or boots should be forbidden, and only those worn which admit of warm socks or stockings. Regular exercise daily, especially in cold weather, should be insisted on, patients liable to chilblains being too often kept indoors; hanging over the fire before and after going out is especially to be forbidden. A chilled sponge bath in the morning, followed by good friction, this being repeated before a fire at night, so as to send the patient to bed in a glow; improvement in the diet as well as the addition of meat or its equivalent at breakfast, a glass of port wine or half a pint of milk with f℥ss. of rum in it at 11 a.m. and a course of bark and acid if need be, are all points of importance. So, too, at night the bedroom should be warmed, and knitted 'bed boots' worn, scarcely anything being more likely to conduce to or maintain chilblains than the custom of sending weakly children from heated sitting rooms into chilly bedrooms.

Locally, as long as chilblains are unbroken the treatment should be directed to judicious stimulation of the part. Thus, frequent bathing should be made use of in cold or just chilled salt water, or in water to which mustard has been added, the bathing being followed by persevering friction with a soft towel or flannel. The following stimulating applications will be found useful in the earlier stages. One part of Tr. iodi to two of Lin. saponis gradually increased to equal parts; one part of Tr. cantharidis to six of Lin. saponis; camphor dissolved in eau de Cologne, or equal parts of turpentine and olive oil. Nothing relieves the intolerable itching better than the Linimentum belladonnæ painted on and allowed to dry, or the application of Papier Fayard. Another application, which is only to be used where the chilblains show no sign of breaking, is aconite, opium, and chloroform liniments āā f℥ss., to be well rubbed in night and morning with soft flannel. Where vesication has taken place, flexile collodion, or the anodyne amyl-collodion will be found useful. In the stages of ulceration or sloughing, treatment appropriate to those conditions must be adopted.

As regards internal remedies, probably small and repeated doses of opium are the most trustworthy. W. H. A. Jacobson.

CHILDHOOD, the Surgical Affections of, are special only in the sense that they occur in children; for with very few exceptions children are liable to the same diseases and accidents as adults. Any peculiarities, which disease manifests when occurring in childhood, depend not on special types of disease, but on certain physiological differences which distinguish the juvenile and adult periods of life. CHILDHOOD extends from birth to the thirteenth or fourteenth year of life. The first twelvemonth of this period is the *period of infancy*; the last year or two border on the age when *childhood* gives place to *adolescence*. The former is characterised by an excess of animal over intellectual growth, the latter is the period when intellectual activity begins to assert itself over mere bodily growth, and when the organs undergo higher development and not merely increase in size. These facts not unnaturally influence the nature and course of any disease which occurs at the several periods named. The bodily TEMPERATURE of young children is rather higher than that of adults, and it is more easily disturbed. Thus in children's hospitals the temperature of the majority is found to rise after the parents have left on visiting days. Little articles of diet surreptitiously brought in no doubt must be credited for something, but it is chiefly the mental effect on the children which causes this rise. So, too, after accident or operation: the temperature, therefore, is not quite so reliable a guide as in adults, and variations mean less than with them. On the other hand, children are more susceptible to changes in the external temperature than adults, and great care is necessary with regard to this point; the temperature of the sick room should be kept at a uniform point night and day, and some five to ten degrees higher than for adults. Infants are peculiarly susceptible to cold, and not a little infantile mortality is due to too low a temperature, especially during the night, when the physiological functions are at their lowest ebb. Errors are more likely to be prejudicial if the temperature of the room has been kept up during the day.

The question of SHOCK is one of the first which occurs to the surgeon's mind, when he is called to a severe accident, or when he has to decide on an operation. It is usually asserted that children more readily succumb to shock than adults. In the writer's opinion this is not the case. The intense vitality of children, the integrity of their vascular and emunctory systems, the absence of unfavourable psychological influences which so beset adults, are factors of the greatest moment all in their favour; and the success which has attended even such severe operations as abdominal section, ovariotomy, extirpation of the kidney, and many others, are testimonies in favour not only of a child's endurance, but of its great recuperative power. A matter of great importance after operation or accident is the assuaging of pain. PAIN is very exhausting, and children do not bear pain so well as adults. It is owing doubtless to the saving of pain by chloroform—which children take better than any other anæsthetic—that so little shock is observed after severe operations; and if opium in full (proportionate) doses be afterwards administered to save subsequent pain, shock can be largely banished from children's surgery. The writer gives one minim for each year of life, and one for the operation; thus for a child three years old, four minims of the tincture of opium would be given after a painful operation.

HEREDITY plays a very important part in the causation and type of disease in early childhood: the worst effects are usually found in organs which are most rapidly developing. As age progressively advances, and as a child's tissues, so to speak, become more and more independent of their ancestry, hereditary influences gradually weaken. Thus, an infant born with congenital syphilis almost invariably suffers within the first few weeks of birth—the stronger the hereditary taint, the more severe will the disease prove in the child, and the earlier will it manifest itself, and *vice versâ*. In regard to those changes which we call strumous, they tend gradually to pass away as age advances, under suitable treatment and surroundings; hence in the treatment of the lesser manifestations of this diathesis it is highly important to gain time; so, too, in prognosing as to strumous lesions, either of the glands or of the joints, or elsewhere, provided ordinary care be exercised, time itself will frequently bring about a cure. Many a joint may be saved from excision by expectant treatment, if directed to the general as well as to the local condition, and patiently persevered in.

CONSTITUTIONAL PECULIARITIES greatly modify the growth of a child. Rickets, for instance, may manifest itself by no other visible sign than that of retarded, stunted growth, so that 'backwardness' in children is often synonymous with rickets. It is important to recognise this fact, for cod-liver oil, and shampooing the limbs with sea-water, will often work marvels in a comparatively short time.

Much more than in adults, INJURIES in children tend to bring out constitutional peculiarities; a syphilitic or rheumatic taint will often remain latent until an injury calls it forth. Thus strumous affections are often traceable to a slight injury. Acute tuberculosis, especially of the brain, is often set up by a fall or blow on the head. Disease of joints follows slight wrenches or blows, such as would be inoperative in a strong constitution. After operations and accidental (open) injuries, children sometimes get scarlet fever, and occasionally other similar diseases. In the same manner a general eczema may be set up in children predisposed thereto by very slight external irritants—rough flannel, coarse soap, flea-bites, slight scalds, or the use of strong external applications. In certain but few cases vaccination is followed by a general and troublesome eczema, which is due to the irritation set up by rubbing the vesicles, or even of unskilfully taking out lymph.

In infants, those parts are chiefly liable to take on disease or disordered function which have been latest perfected, or those which are still in a condition of active development. Hence HERNIA is exceedingly common in infants: the tunica vaginalis testis has been so recently shut off from the general peritoneal cavity, or but imperfectly shut off, that a very slight cause is sufficient to open it up again. The commonest cause is tight bandaging. Mothers and nurses think it supports a child's abdomen to keep it tightly swathed in a flannel binder. The practice is a bad one, for it does not allow for changes in size of the abdomen, due to flatulence or to the ingesta, and the intestines pass into the scrotum, reopening the hardly closed abdominal rings for the purpose. In a large percentage of cases, the removal of the tight bandage allows Nature to reassert herself, and spares the child the discomfort of wearing a truss. Another very troublesome affection of early life, connected with development and growth, is acute EPIPHYSIAL DISEASE. Its commonest cause is congenital syphilis, but it also occurs in other cachectic subjects; it results too from, or is apparently started by, slight injuries in children not manifestly the subject of specific disease. This liability to disease at the epiphysial junctions lasts all through childhood; but as age advances, the disease, when it occurs, assumes a more chronic form. Slight injuries, which would be otherwise harmless, suffice to set up disease in these parts, on account of the great physiological activity which is taking place. In estimating obscure injuries about the joints of young persons, the epiphysis and its possible participation in the condition should always be borne in mind. The BURSÆ in connection with the muscles surrounding joints—the hip-joint especially—are liable on slight provocation to enlarge and suppurate. In opening these, it should be remembered that they are frequently connected with joints and may involve them in suppuration.

The developmental activity of childhood predisposes to MORBID GROWTHS; hence the frequent occurrence of tumours, in the immediate causation of which injury seems to take a considerable share. Excluding the congenital tumours (which are generally either cystic or fatty), the most common is sarcoma; of this it may be said that the younger the patient, the greater its malignancy, and the greater the need for early and radical treatment.

In the *Treatment* of all affections of children, it is highly important to remember the possibility of a mixed diathesis; thus syphilis and struma may exist in the same child, and be about equally balanced; the writer has seen many such cases, in which, for instance, mercury alone has failed to cure a child of its congenital syphilis; but when combined with cod-liver oil has been quite successful. On the other hand, cod-liver oil in strumous children is often greatly aided by a judicious use of some mercurial. Syphilis and rickets also frequently coexist. Success in treatment will depend on the combined use of those drugs which are known to influence the diseases—more or less of the one or the other being given in proportion as one diathesis appears to predominate over the other. Treatment should always be continued for some time after the local injury or disease has subsided; for the constitutional element remains present, ready to assert itself on the slightest provocation.

As regards *drugs*, whether for internal or external use, it may be said that children are a little more susceptible to their influence than adults. Opium especially is thought to affect children more readily than adults; on the other hand, children tolerate both mercury and belladonna better than adults. Mercury especially they bear in full and long-continued doses without ill-effects, probably owing to the large amount of milk they take, which deprives it of its irritant effects. There is the same individual susceptibility to drugs which is met with in adults. In prescribing, therefore, it is wise to commence with small doses, and repeat them until the desired physiological effect is produced.

ROBERT WILLIAM PARKER.

CHIMNEY-SWEEP'S CANCER. *See* Scrotum, Injuries and Diseases of the.

CHLOASMA.—This name is now given to circumscribed hypertrophy of pigment in the skin, occurring in large patches, and also to diffused increase of pigmentation due to a variety of causes; the term melasma or nigrities is applied when the increase is so excessive as to give the skin a very dark, nearly black, colour.

Causes.—Exposure to the sun produces the well-known hypertrophy called sunburn, and people who are fond of sitting much before the fire are apt to get reticulated pigmentation over the shins (*Chloasma caloricum*). The application of irritant substances to the skin, such as blisters and mustard plasters, is very frequently followed by an increase of pigmentation, which is sometimes permanent (*Chloasma toxicum*). Again, mechanical irritation of the skin by rubbing and scratching, as by the pressure and friction of tight bandages, and scratching to relieve intense itching, as in prurigo and phthiriasis, will give rise to pigmentation (*Chloasma traumaticum*). Further, any disease of the skin which is accompanied by long-continued hyperæmia, especially if itching be superadded, is commonly followed by pigmentation; thus scabies, eczema, psoriasis, lichen planus, are often succeeded by increased pigmentary deposit. It is obvious that all the above-enumerated forms have one important factor in common, and that is hyperæmia of the affected skin as an antecedent; whether this be due to heat and exposure, to chemical or mechanical irritation, or to disease. They may therefore be logically grouped together as varieties of pigmentation due to direct affection of the skin, or *Chloasma idiopathicum.*

Increased pigmentation of the skin also occurs in connection with physiological and pathological processes which affect the whole system, without directly implicating the skin; the affection is then called *Chloasma symptomaticum.* Pregnancy constantly gives rise to pigmentation of the face, neck, nipples, and linea alba (*Chloasma gravidarum*), while the most various diseases and functional disorders of the uterus and ovaries are accompanied in many cases by a similar affection (*Chloasma uterinum vel hepaticum*). This variety is met with chiefly on the face, especially the forehead and temples, as smooth patches of variable size and shape, circumscribed or diffused, and varying in colour from yellowish to a liver-coloured, deeper brown, or smoky tint; it sometimes extends to the neck, backs of hands, and trunk; it usually subsides on removal of the uterine or ovarian condition on which it depends. Strong mental emotion, especially fright, and various functional affections of the nervous system must be mentioned among the causes of increased pigmentation. It occurs also in various chronic exhausting diseases (*Chloasma cachecticorum*); it is often well-marked in the cachexia of cancer, inherited syphilis, malaria, phthisis, and scrofula, and in a lesser degree in Bright's disease and myxœdema.

But the most striking kind is the bronzing of the skin which occurs in Addison's disease (*Melasma suprarenale*); this is most strongly marked on exposed parts, as the face, neck, and hands, and varies in tint from the yellowish-brown of sunburn to a deep greenish-brown colour; the nipples, axillæ, and genitals are often so strongly pigmented as to be nearly black; the pigmentation is diffused, but patches of a deeper tint occur here and there on the brown skin, and pigmented spots are also found on the mucous membrane of the mouth and elsewhere.

In a few cases of generalised melanotic sarcoma, the skin, especially of the face and hands, has been noticed to assume a slaty colour. Syphilis occasionally gives rise to pigmentation of the skin apart from that which is so constantly met with as following syphilitic eruptions. This affection, which has been chiefly described by French authors under the name 'Syphilide pigmentaire,' is met with almost exclusively in women in the secondary stage, chiefly on the neck, where it forms a reticulated blotching of a light coffee-colour. It is sometimes more extensive, and has now and then been found in males. As it is met with when all other signs of syphilis are absent, and is quite uninfluenced by treatment, it is probably to be viewed as a form of chloasma. It should be noted, however, that several observers look upon the discoloration as due, in great measure, to atrophy of pigment in the parts enclosed in the brown meshes, and therefore class it with leucoderma.

The differential diagnosis of chloasma is not difficult; practically the only disease with which it may be confounded is tinea versicolor; but this occurs chiefly on the trunk, never on the face, is slightly scaly, especially on scratching with the fingernail, and nearly always itches; whereas chloasma is commonest on the face, has a smooth surface, and does not itch. Microscopical examination of the detached scales of tinea versicolor, after treatment with potash, shows the characteristic fungus, which is of course absent in chloasma. A simple method in a doubtful case is to paint the surface with a weak solution of iodine; this gives an intense reddish-brown tint in tinea versicolor, but no darkening in chloasma.

As chloasma depends upon the deposition of increased pigment in the epidermis, treatment can only be of service by removal of the affected cuticle; therefore all substances which cause desquamation are of value. The best of these is corrosive sublimate, which may be employed as a lotion of about one grain to the ounce; but an ointment of white precipitate or sulphur, or painting with iodine, will also be efficacious, although not so active. For congenital excess of pigment, *see* Mole.

John Cavafy.

CHLOROFORM. *See* Anæsthetics.

CHOLECYSTOTOMY is an operation which consists in opening a dilated gall-bladder through an abdominal incision, for the removal of impacted calculi.

The presence of *biliary concretions* does not, as a rule, give rise to any urgent symptoms beyond those due to occasional attacks of so-called biliary colic, caused by the passage of a gall-stone through the ducts. Cases are even met with *post mortem* where the gall-bladder is found completely packed with closely wedged calculi, of which no indication had existed during the patient's lifetime. Occasionally, however, the presence of such concretions may lead to inflammation of the gall-bladder, followed by suppuration and the ultimate discharge of its contents through an opening in the abdominal wall, resulting in the formation of a biliary fistula.

Dilatation of the Gall-bladder, consequent upon obstruction of its duct by an impacted calculus, is a somewhat rare affection, more commonly met with in women than in men. The retained fluid, consisting of bile mixed in greater or lesser proportion with mucoid secretion from the lining membrane of the gall-bladder, may occasionally become purulent as the result of inflammation of the sac. The distension, if long unrelieved, exposes the patient to the risk of sudden rupture of the dilated bladder —an accident almost inevitably followed by fatal peritonitis.

Symptoms.—1. *Recurrent paroxysmal attacks of colic*, referred to the right hypochondrium, and thence radiating through to the back and loin as well as downwards towards the thigh, are usually the first indications of the impaction of a gall-stone. The pain, which is commonly very severe, and accompanied by retching or vomiting, is from the first readily induced by exertion of any kind. As the dilatation progresses it becomes, however, more or less constant in character, while subject always to recurring paroxysms. 2. *Jaundice* is not a common symptom of gall-stone impaction obstructing the *cystic* duct. Its presence in any case would indicate closure of the *common* duct, a condition which, if unrelieved, usually proves fatal before the occurrence of any marked dilatation of the gall-bladder. 3. *Formation of a tumour in the right hypochondrium.*—The fundus of the normal gall-bladder projecting below the margin of the right lobe of the liver opposite the ninth costal cartilage, lies beneath the outer border of the right rectus muscle, and its tendency when enlarging is to project downwards and forwards towards the umbilicus. A *dilated gall-bladder* usually constitutes a somewhat pear-shaped or semi-globular tumour, overlapped by intestine along its lower and inner borders. When of moderate size, its shape and free mobility may occasionally lead to its being mistaken for a movable kidney. It is commonly smooth on the surface and of uniform contour, either firm or elastic on palpation, according to the degree of distension, and often the seat of much tenderness, especially after being handled.

Diagnosis of the affection during its early stages is often a matter of considerable difficulty, unless a well-marked history of the passage of gall-stones on previous occasions be obtainable. In any given case the following conditions may require elimination before arriving at a definite conclusion:—1. Malignant disease of the liver, of the gall-bladder, of the stomach, omentum, or pancreas; 2. Abscess in or about the liver; 3. Hydatid disease; 4. Renal tumours, solid or fluid; floating kidney; 5. Dermoid or ovarian cysts. *Aspiration* of a cystic tumour suspected of being a dilated gall-bladder, although useful as a means of diagnosis, especially with a view to detecting the presence of calculi, is not altogether devoid of risk, from the possibility of the subsequent escape of irritating fluid through the cyst-puncture—an accident which may well lead to disastrous consequences, should the swelling prove to be due to hydatid disease. A small *exploratory incision*, if carried out with all due antiseptic precautions, is a much more satisfactory and safe proceeding in doubtful cases.

The operation of Cholecystotomy is performed as follows:—A vertical incision two inches in length, commencing about an inch and a half below the costal margin, is made over the tumour along the outer border of the right rectus muscle. All hæmorrhage should be arrested by pressure-forceps before opening the peritoneum, which is to be freely divided to the same extent as the skin. The surface of the tumour having been thus exposed, the surgeon next introduces one or two fingers for the purpose of ascertaining its connections and detecting the cause of obstruction. Sponges are now inserted around the incision to protect the peritoneal cavity, and the gall-bladder is evacuated by means of the aspirator. Before the canula is withdrawn, the now flaccid cyst should be seized by pressure-forceps applied above and below the seat of puncture, and drawn well forward through the abdominal wound. Its wall is then incised vertically to the extent of one inch, and the sides of the opening are held apart by forceps while the interior of the sac is sponged out dry. Introducing his finger, the surgeon feels for an impacted calculus, and, if possible, removes it with the help of suitable forceps. Should he be unable to grasp the stone, an attempt may be made to dislodge it by external manipulation through the wall of the duct, or, failing this, it may be crushed from without by means of carefully-padded forceps, the fragments being afterwards squeezed onwards through the duct, or back into the gall-bladder and thence removed. Finally, the condition of the ducts should be thoroughly explored, in order to make sure that no obstruction remains.

A rubber drainage-tube is now inserted in the gall-bladder, and the abdominal incision is closed around it by sutures which must include the edges of the divided peritoneum, together with those of the opening in the gall-bladder. A carbolised sponge is placed over the end of the tube, and an antiseptic dressing is applied over all. The discharge of bile is usually very profuse for the first thirty-six or forty-eight hours, after which it gradually lessens in amount. The sutures may be taken out at the end of a week, but the tube should not be removed until all discharge has practically ceased. The fistulous opening left by it usually heals of itself in the course of a few weeks; but, failing this, it may be readily closed by operation.

Another plan of treatment, which was adopted in one case by the writer, consists in closing the gall-bladder incision, after removal of the calculi, by means of a continuous silk suture involving only the muscular and peritoneal coats; the sac is then dropped in, and the abdominal incision is closed in the usual way. The objection to this procedure *without drainage*, lies in the fact that it may not be always possible to make quite certain that all obstruction has been removed at the time of operation; for, if such be not the case, the rapid accumulation of bile or mucus might tend to force open the incision in the gall-bladder, and thus allow of the escape of its contents into the peritoneal cavity.

A further modification of the usual operation, proposed by Dr. Gaston of Atlanta, U.S.A., with a view to obviate the dangers of an unrelievable obstruction of the *common* duct, aims at the establishment of a permanent artificial communication between the gall-bladder and the duodenum. It is conceivable that the procedure suggested might prove useful in certain exceptional instances, but so far its value has not been tested in the human subject.

Cholecystectomy.—*Excision of the dilated gall-bladder* has been advocated by Prof. Langenbuch of Berlin. The operation, however, apart from the immediate risks entailed by its performance, does not necessarily ensure restoration of patency to the *common* duct, and cannot therefore be said to afford any advantage over the more usual method of treatment in these cases.

William Appleton Meredith.

CHOPART'S AMPUTATION. *See* Foot, Amputations in the.

CHORDEE.—In the acute stage of gonorrhœa the patient usually suffers at night, when in bed, from frequent attacks of very painful erection, with bending and slight twisting of the penis. The concavity of the arc is almost always directed downwards, but some few instances have been observed of lateral and also of upward bending. This condition is the result of acute inflammation along the urethra and of general congestion of the penis. The erections are excited by irritation of the prostate, and the associated pain is due to the congested and engorged condition of the penile spongy tissue. The walls of the urethra, together with the peri-urethral tissue, and more or less of the corpus spongiosum being stiffened in consequence of inflammatory deposit, become far less extensile than the other structures of the penis, and so, as the corpora cavernosa become distended, yield but in a slight degree.

This, which is the generally accepted view as to the causation of chordee, has been opposed by Mr. Milton, in whose opinion the bending of the penis is due to spasm of the special muscular elements of the urethra.

For the treatment of chordee, see Gonorrhœa.

CHOROID, Diseases of the.—The choroid is a vascular membrane which lines the posterior part of the eyeball, as far forward as to the margin of the ciliary body (q. v.), and is interposed between the retina and the sclera. It is perforated for the passage of the optic nerve, and is loosely attached to the sclera by a very slight connective tissue until it reaches the ciliary region, where, as well as in the immediate neighbourhood of the nerve-entrance, the connection between the two structures is closer and more intimate. The choroid consists essentially of a web of blood-vessels, which are coarser and larger on the side turned towards the sclera, and capillary on the side turned towards the retina. The principal veins of the choroid are arranged in a series of whorls, called *vortices*, five or six in number, the veins of each vortex running to a common centre, and there uniting in a single vein, which passes out of the eye through an oblique channel in the sclera. Internal to the vortices there is a layer of vessels of smaller size, and internal to these there is the so-called *chorio-capillaris.* The intervascular meshes of the membrane contain a variable amount of pigment, usually of a dark chocolate-brown colour, and between the chorio-capillaris and the perceptive layer of the retina there is a layer of pavement-epithelium, the cells of which, in dark eyes, are loaded with pigment to such an extent that the layer is rendered practically opaque, and conceals the choroidal structure from ophthalmoscopic examination. This layer of pigmented epithelium was formerly described as part of the choroid, but most modern histologists refer it to the retina. By its intermediation, the two membranes are in intimate union with each other, and the perceptive layer of the retina derives its nourishment from the chorio-capillaris. Besides connective tissue, blood-vessels, and pigment, the choroid contains many filaments derived from the short ciliary nerves, and the long ciliary nerves pass forward between it and the sclera until they approach the ciliary region. In man, the choroid has, presumably, no other function than to provide for the nutrition of the retina, and to convey vessels and nerves to the ciliary body and iris, but in some of the lower animals it is comparatively more voluminous, and in many birds it projects into the cavity of the eyeball in a large fold called the *pecten.* There is reason to believe that, in such conditions, it ministers to accommodation by permitting considerable variations in the quantity of blood which is contained within the eye at different times.

Ophthalmoscopy.—Our knowledge of the diseases of the choroid is derived chiefly from the ophthalmoscope, and hence the normal aspect of the membrane is the first point which requires description. This aspect depends entirely upon the amount of pigment which it contains. In the dark races, and even in dark Europeans, the choroid itself is invisible, being completely screened from view by the layer of pigmented epithelium, which presents a uniform dark brownish-red surface, broken by the comparatively white circle of the optic disc, and seen through the slight opalescence of the retina. In Europeans, with brown or hazel eyes, it is seldom possible to see choroidal vessels. In them the membrane forms a red, or orange-red, background, against which the retina itself is scarcely visible, although the arborescent ramifications of its blood-vessels are conspicuous. As seen in the direct method of ophthalmoscopic examination, the choroidal background assumes a finely granular appearance, and the optic disc is often bordered by a crescentic line, or even by a complete circle, of pigment, which appears almost black by contrast. In very light eyes, pigment is comparatively absent, both from the epithelial layer and from the choroidal tissue, and in such conditions the latter is conspicuous. The vessels of the choroid are distinguished from those of the retina not only by their situation on a deeper plane, but also by the manner of their arrangement. The retinal vessels are arborescent in their distribution; the larger vessels of the choroid, which form radii to the centres of the vortices, are almost parallel to one another. In very light eyes, the inner surface of the sclera is visible through the meshes of the choroidal vessels, which then evidently rest upon a white background.

In certain morbid conditions the pavement epithelium of even dark eyes loses its pigment, and exposes the choroidal tissue to view. When this occurs, the parallel vessels are seen to be separated by more or less linear interspaces, which are filled by the loose pigment of the choroidal stroma, and hence appear dark by comparison with the vessels. The resulting striation, which is manifestly behind the retina, and over which the retinal vessels pursue, independently, their arborescent course, presents a very curious and interesting picture.

The vessels of the retina are chiefly contained in the anterior layer of that membrane, which consists essentially of nerve-fibres and connective tissue. Between this layer and the choroid other retinal layers are interposed, which consist essentially of nervous elements, with but little connective tissue, and which scarcely at all modify the ophthalmoscopic image. When the retina itself, or rather the connective tissue of the fibre-layer, becomes the seat of morbid changes, these must inevitably, in some degree, conceal the retinal vessels from view, and, conversely, when the retinal vessels are plainly visible, the retina itself must be free from disease. Hence, when there is any morbid appearance in the fundus of the eye, and when, across and in front of this morbid appearance, between it and the spectator, the retinal vessels pass in an unchanged condition, the inference is inevitable that the appearance is posterior to the retina, or, generally speaking, that it is in the choroid. The chief exception to this statement is furnished by the disease commonly described as 'pigmentary retinitis,' a disease which affects chiefly the contiguous layers of the retina and choroid at their surfaces of apposition, and which, in the writer's opinion, should be classed among choroidal affections rather than among those of the retina.

A patch of inflammation in the choroid is liable to produce two marked changes, obliteration and atrophy of the blood-vessels of the affected area, and displacement of its pigment. These changes produce transparency of the tissue, and hence render the sclera plainly visible. The seat of a localised choroiditis will usually be left as a white spot, surrounded by a narrow black border. The whiteness is that of the inner surface of the sclera, and it will sometimes be broken or diversified by remains of the original choroidal stroma. The black border consists of displaced pigment, which has infiltrated the ring of tissue immediately around the inflamed structure.

Pathology.—The anatomical position and relations of the choroid render it liable to become implicated in morbid changes which originate in other tissues. It not infrequently participates in inflammations of the sclera at the two regions where it is in close union with that structure, and we then have the conditions which have been described under the names of 'sclero-choroiditis anterior' (*see* CILIARY BODY, Diseases of the), and 'sclero-choroiditis posterior' (*see* REFRACTION, Errors of). It is prone to participate in iritis, which may extend to it by direct contiguity, constituting irido-choroiditis. It is still more prone to participate in cyclitis. It is early involved in that general plastic inflammation of the eye which is called sympathetic ophthalmia, or in that still more rapidly destructive form of general inflammation leading on to suppuration, which sometimes follows surgical or accidental injury, and is sometimes produced by blood-poisoning. It suffers in all forms of glaucoma, whether primary or secondary. Its share in these various affections does but constitute a complication of them, and will be found described in the articles in which they hold the first place. The writer proposes here to confine his attention to those diseases of the choroid which, as far as can be ascertained, originate in the membrane itself.

The history of development proves the choroid to be essentially a dermal structure, and many of its diseases bear a marked analogy to those which affect the skin. They are of high importance to vision, but they owe this importance to the accident of locality. An inflammation of the choroid strikes at the root of the nutrition of the perceptive elements of the retina; and hence, when it occurs anywhere near the centre of the fundus, it is always attended by early and great disturbance of vision. Where the disease passes into atrophy, the perceptive elements of the retina participate in the change, and a permanent blind spot, of situation and magnitude corresponding to that of the atrophy, will be the result. In this respect, the inflammations of the choroid present a marked contrast to those of the retina. The latter are chiefly situated in the connective tissue of the fibre-layer, and hence, even when the morbid changes are very conspicuous, they may not affect vision at all.

INFLAMMATION.—The various forms of primary choroiditis have been distinguished by names more or less descriptive of the aspects which they usually present, so that choroiditis has been called disseminated, areolar, wandering, circumscribed, and the like. The differences thus noted are sometimes rather accidental than essential; and the points of chief importance, in any case, are to determine whether or not the disease is syphilitic, and whether it is confined to peripheral portions of the membrane, or is likely to extend to the neighbourhood of the yellow spot.

Disseminated choroiditis.—In the typical form the fundus of the eye is sprinkled over with spots, which may be compared to those of a cutaneous eruption. Each spot, in its origin, has been a sort of pimple, formed of an aggregation of cells in the choroidal tissue. The pimple becomes the seat of a localised inflammation, and ultimately shrinks, destroying in its shrinkage the adjacent tissues, so that its seat is marked by a sort of scar. This scar is surrounded by a line of pigment, and its central parts are white, the colour of the sclera showing through the thin layer of choroidal and retinal remains which the inflammatory process may have spared. The parts around each spot are not affected, and the spots themselves are usually most abundant near the equatorial region, and comparatively seldom approach the yellow spot. Practically, they are of little importance to vision, insomuch that the occurrence of the disease may have been unnoticed. In examining the eyes of children who are the subjects of inherited syphilis, it is frequently found that the more peripheral parts of the fundus are sprinkled over with small white dots, each encircled by a pigment line, and showing that disseminated choroiditis has occurred and has been recovered from. When the earlier stages of the process can be observed, each spot appears as a slightly yellowish point, surrounded by a narrow area of increased vascularity, and which, by very careful ophthalmoscopic inspection, may be distinctly seen to be an elevation. The yellowish centre gradually passes into the whiteness of atrophy, and the surrounding vascular area gradually passes into a line of pigmentation.

The *areolar choroiditis* of authors is a form of disease scarcely distinguishable, as far as its essential nature is concerned, from the foregoing; but, from the locality which it is more prone to attack, it is much more serious in its consequences. The process of inflammatory thickening in the choroid seems to be much of the same character, but the individual patches are larger, they are usually situated near to the macular region, on which they not infrequently encroach, and they are apt to coalesce with one another. Hence, even if the macula be spared, the ordinary result of areolar choroiditis is to obliterate a large and irregular portion of the visual field. The aspect presented by the fundus is that it is studded, around the optic disc and the macula, with oval or irregular patches, centrally white and bordered by pigment; the whiteness of the centres being often broken by a few remains of choroidal vessels. Besides these patches there will be small black spots, some of which are probably accidental aggregations of pigment, while others, according to some observers, are fresh patches in an incipient stage.

Wandering choroiditis.—In this form there are no sharply bordered spots, either of primary exudation or of secondary atrophy, but the choroidal surface is invaded, here and there, by irregularly shaped patches of effusion, comparable to the irregular patches of certain cutaneous eruptions. Over each of these patches there is a damping of the brightness of the tisssue, and this damping is succeeded, in time, by irregular pigmentation, and by changes which approach, but seldom quite amount to, absolute atrophy. It often happens that wandering choroiditis may exist for a long period without exciting attention, that it ultimately either actually invades the macular region, or approaches sufficiently near to it to produce disturbance of vision, and that, if then treated with sufficient energy, its progress may be wholly arrested, and central vision completely restored. In such cases, over the lateral areas, in which it had previously run its course, no improvement is usually to be expected.

Central choroiditis.—Besides the foregoing essentially chronic affections, we sometimes meet with choroiditis in a more acute form, and it is then apt to invade the region of the macula in the first instance. The disease appears to commence as a patch of effusion in the choroid, immediately beneath the macula. From the very first it produces distinct impairment of central vision, the point looked at appearing to be obscured as by a patch of fog; while, in consequence of the disturbance of the retinal elements by swelling underneath them, objects are distorted, and often appear to be smaller than natural. De Wecker has described this state as being almost invariably syphilitic, and as appearing between the ordinary secondary and tertiary periods, often many years after the primary infection. He attaches great importance, as a diagnostic sign of syphilis, to a very slight turbidity of the vitreous, situated chiefly in the layers nearest to the retina, and presenting an aspect as if the humour were beset with fine dust particles. This special form of turbidity usually obtains, at first, only in front of the macula, and is only to be observed by the very careful use of the ophthalmoscope. It is probably the physical cause of an appearance frequently described by patients—a sort of quivering or shimmering in the fog by which the objects of direct vision are obscured. Such cases are always of great gravity; and the appearance of a central visual cloud, in a patient known to have suffered from syphilis, is a matter which calls for prompt action on the part of the surgeon. Under the most favourable conditions, syphilitic central choroiditis is likely to be a serious and protracted affection; which, if neglected at the outset, will almost inevitably extend to the retina, and may involve both this structure and the choroid in one common ruin, with consequent total destruction of vision.

Treatment.—In the treatment of choroiditis, the chief matters to be taken into account are the degree of acuteness of the disease, the extent in which it seems to threaten the region of the macula with invasion, and the evidence for or against its being of a syphilitic character.

In a certain proportion of cases, in patients who apply on account of some superficial ocular trouble, or of some error of refraction, we may find the more peripheral parts of the fundus studded over with the scars of disseminated choroiditis. If the central vision is good, and if the ophthalmoscope discovers nothing but scars, no spots of apparently recent disease, we may consider that we are looking at the relics of a past storm, and may dismiss the scars from consideration as completely as we should dismiss the scars of small-pox.

In cases of areolar choroiditis, or in cases of wandering choroiditis in which vision has recently become affected, we shall probably find, besides more or less atrophic or degenerative change, places in which some active mischief is in progress. Here and there, the brightness of the choroidal colour will be somewhat damped by effusion, and a careful use of the ophthalmoscope will perhaps show that, in these places, the retina is somewhat raised by subjacent swelling. The bending of the retinal vessels, as they pass over the margin of a suspicious spot, will often afford evidence of its being on a higher level than the parts immediately around it. When such appearances are presented it is necessary to recognise the existence of grave peril to the sight, and to insist upon the necessity of submission to careful and even rigorous treatment.

Having, in the first place determined, whenever the determination is possible, the presence or absence of a syphilitic taint, the next care of the surgeon must be to investigate thoroughly the general conditions of the patient, with regard both to function and to diathesis. The urine should be examined, not in a perfunctory manner, but thoroughly; with reference to quantity and specific gravity, and to amount of urea, as well as with reference to albumen and sugar, to lithates or phosphates. The liver should be examined by palpation in the erect posture; and, in a large proportion of cases, there will be good reason for commencing the treatment by the administration of two or three doses of a mercurial alterative, followed by moderate, but sufficient, purgation. The ordinary regimen and habits of life should also be inquired into, and corrected if found to be ill-regulated.

When these preliminaries have received attention, and when no syphilitic taint is discoverable, the medicine which the writer has found most efficacious is the mercurial perchloride, given to an adult in doses of the sixteenth of a grain three times a day, and usually combined with a small quantity, say three to five minims, of the tincture of perchloride of iron. Many practitioners direct such a combination to be taken immediately after food; but it will sometimes be found that this course is followed by dyspepsia, as if the iron interfered with the secretion of the gastric juice. Sir Henry Thompson has pointed out that, when this happens, the iron will often be perfectly well borne if its administration is deferred until three hours have elapsed after a meal.

An important adjunct to treatment will often be the abstraction of blood from the temple by Heurteloup's or some other artificial leech. The process is, in fact, a form of cupping, and it is more advantageous than the use of the natural leech, which abstracts the blood more slowly, and after prolonged suction which produces a congested state of all the neighbouring parts. About two fluid-ounces of blood should be taken quickly, and the bleeding may be repeated from time to time, according to the local and general conditions of the patient. It is desirable entirely to screen the eye from light for some hours after the bleeding; and, for this purpose the little operation is best performed at nightfall. The patient should remain in bed during the whole of the next day, in a completely darkened room, and should not be exposed to light until the morning of the third day.

Even then, the exposure should be careful and gradual; and, especially in the spring and summer seasons, dark spectacles should be worn in full daylight. All functional use of the eyes, even if one of them is quite sound, should be strictly forbidden, and a reader and amanuensis must be employed if there should be any business which imperatively requires attention.

The absorption of effused materials may often be much promoted by the use of pilocarpine diaphoresis, which serves to empty the blood-vessels without exhausting the patient. The best preparation for the purpose is the pilocarpine hydrochlorate, in the form of a ten per cent. solution in distilled water. For an adult, two minims of this solution may be injected hypodermically as a commencing dose, and it will generally be found that three or four minims may be given on subsequent occasions. The patient should go to bed, with warm coverings, and the dose should be given about an hour after breakfast. The place of injection is immaterial, although the first signs of perspiration will appear in the immediate neighbourhood of the puncture. In some people, the diaphoresis will be attended by free salivation. The whole effect terminates in about three hours, after which time the patient may rise, be rubbed dry, and return to his or her usual avocations.

By the adoption of such a course as this, the progress of the disease will often be arrested, and the central vision, if it were only beginning to suffer, will be restored. Even when good results are speedily obtained, it is desirable to continue the mercurial perchloride for several weeks, and at all events as long as any appearance of effusion or recent mischief is visible with the ophthalmoscope; and only to permit a very slow and careful return to the functional use of the affected organ or organs.

In the more acute cases of disturbance of central vision, with the appearance of a quivering cloud over the fixing point and with distortion of objects, the surgeon has to deal with an acute and highly perilous syphilitic affection. De Wecker advises that recourse should be had to rapid mercurialisation, preferably by inunction; but the writer is strongly of opinion that mercury, as a means of arresting the present symptom in the late forms of syphilis, whatever that present symptom may be, is decidedly less trustworthy than iodide of potassium, given energetically in the largest doses which can be borne. He would begin with ten grains three times a day, and would increase or diminish this quantity according to its effects. If symptoms of iodism should occur, the dose should be diminished to any necessary extent. If there were prompt improvement, and if this, after the lapse of a short time, seemed to be no longer continued, the dose should be increased again and again, if the described conditions should recur. The facts which point to the great value of the iodide in arresting a syphilitic symptom at a late period of the disease, point also to its remarkable inefficacy as against the syphilitic taint—a taint which can only be eradicated, when it can be eradicated at all, by the persistent use of mercury. In such a case as that now under consideration, the object of the writer would be, first to save the eye from destruction by the iodide of potassium, and then to cure the patient of his syphilis by mercury, which, for this purpose, should be continued for something like a twelvemonth. In any instance in which the administration of the iodide was not followed by speedy improvement, that is to say, by improvement within the first four or five days, it would be most judicious to lay it aside, and to proceed at once to mercurial treatment, not in the manner advised for the milder forms of choroiditis, but so as to produce a trace of effect upon the gums as speedily as possible. For this purpose, the surgeon would have his choice between inunction, fumigation, and administration by the mouth, and would be much guided by the general state and surroundings of the patient.

In many instances, the slight turbidity of the vitreous body, which has been already noticed, is prone to pass into turbidity of a coarser kind, composed of flocculent masses of exudation-material; and these, by their ready mobility within the eye, show that the vitreous itself has undergone fluid degeneration. Such a condition affords ground for a very unfavourable prognosis, since absorption of effused products within the vitreous is accomplished with extreme slowness, even if at all; and their formation indicates the existence of a very serious amount of morbid change. It sometimes occurs, however, that the affection of the choroid will subside under treatment and that the function of the retina may be preserved, while the flocculi remain almost unaltered, and produce obscuration of objects only when they chance to intervene between the point looked at and the yellow spot. In the worst cases, the extension of the disease is not confined to the vitreous body, but passes forwards to the iris and to the cornea, leading to the deposit of numerous dots of inflammatory deposit upon the posterior surface of the latter membrane, as well as to general turbidity of its structure. When such complications occur, they leave but little hope of a favourable issue. *See Keratitis punctata*, under Cornea, Inflammation of the.

In some instances the effusions which are occasioned by choroiditis produce detachment of the retina, and in others they are poured out between the choroid and the sclera, and detach both the internal membranes together. The ophthalmoscopic appearances are much the same in both cases, save that, when the retina is detached alone, it possesses a certain degree of mobility, and floats up and down within the eye something in the manner of the sheet by which waves are imitated upon the stage. When the retina and choroid are detached together, the greater thickness and firmness of the combined structures prevents the occurrence of these floating movements, and furnishes a symptom by which the nature of the elevation may be determined. The only available treatment is to puncture the sclerotic in the region of the detachment, so as to allow the sub-choroidal fluid to escape, and to permit the detached structures to return to their natural position. In some instances this procedure has certainly been beneficial, and reunion to some extent appears to have occurred. In order to make the puncture the eye should be brought under the influence of cocaine, and then, the place of detachment having been exactly ascertained, the conjunctiva should be drawn aside, and a cutting-needle thrust into the eyeball somewhat obliquely, and turned slightly on its axis as soon as the escape of fluid shows that sufficient penetration has been effected. When the fluid has all escaped the needle is withdrawn, and the conjunctiva is suffered to return to its proper position, so as to cover the scleral puncture. No dressing will usually be required beyond a slight pad to maintain closure of the lids during the healing process. The writer's own experience of the effects of this procedure is less favourable than the accounts which have been given of it by others; but it is at least tolerably certain to do no harm.

In cases which terminate unfavourably, and in which choroiditis leads on to complete loss of vision, followed by wasting or shrinkage of the eyeball, the shrunken organ is sometimes a source of danger to its fellow. The material effused into the degenerated choroid sometimes becomes the seat of calcareous deposits, and sometimes undergoes conversion into true bone. In either of these conditions the eye is apt to become painful and tender, and there have been several instances in which it has excited sympathetic ophthalmia. It is therefore always desirable, when an atrophied eye is tender to the touch, and especially when it can be felt to contain hard deposits, to anticipate danger by enucleation.

Suppurative choroiditis.—A brief reference has already been made to the acute form of choroiditis which leads rapidly on to suppuration, and which, in the majority of instances, is either traumatic or septicæmic. In the 'acute panophthalmitis' which sometimes follows the extraction of cataract, the choroid is only secondarily affected by extension from the parts actually implicated in the operation; but in cases of septicæmia, puerperal or other, we frequently see almost complete loss of vision, while the iris and cornea as yet participate but slightly in the morbid action. This, in such instances, probably commences in the venous plexus of the choroid. Not only the iris, but all the other structures contained within the eyeball, speedily become involved in the inflammation, which can scarcely be said to admit of treatment, and which occurs as an accidental complication of a severe and dangerous constitutional malady. The distension of the eyeball is apt, however, to be extremely painful, and the pain thus arising may be relieved, generally speaking, by incising the sclerotic with sufficient freedom to give exit to pus and other morbid products. The expediency of making the necessary incision would depend greatly upon the general state of the patient, but the best situation for it would usually be between the external and inferior recti muscles, on a line extending from the ciliary region almost to the entrance of the optic nerve.

Hæmorrhages.—The choroid is sometimes the seat of hæmorrhages, the pathology of which is obscure, but which occur chiefly in aged people, and probably, like some retinal hæmorrhages, point to the existence of general arterial degeneration. The blood may be effused either between the retina and the choroid, or into the choroidal stroma, or between the choroid and the sclera, or to some extent in all these situations; and the ophthalmoscopic appearances will be governed partly by the precise situation of the blood and partly by its quantity. Choroidal hæmorrhage is attended by sudden loss or great impairment of vision; and the ophthalmoscope discovers a dark patch, generally with sharply-defined borders, over which the retina is visible as a slightly opalescent film, and with the continuity of its vessels unbroken. As by an inflammatory effusion, the retina may be detached from the choroid, or the chroiod and retina together may be detached from the sclera; but, even in the former case, the detached retina is but slightly tremulous, being usually supported by the blood beneath. After a short time the original appearances may be greatly masked by atrophic or other secondary changes, and by the gradual decolorisation of the clot.

The *treatment* of choroidal hæmorrhage must be conducted on general principles. The first indication will be to diminish the probability of further bleeding, the next to procure the absorption of the blood which has actually been poured out. Complete functional rest of the eyes, complete quiescence of the body, gentle purgation, and great moderation in the quantity of fluid swallowed, will afford the chief means of fulfilling the first indication; while the second will call for the careful administration of iodide and bromide of potassium, of perchloride of mercury, or of other remedies suggested by the general condition of the patient.

Choroidal hyperæmia has been described by some authors. It would be difficult to deny that a vascular structure may sometimes contain an excessive quantity of blood; but it would be impossible to draw any line between physiological and pathological vascularity, or to assign any symptom by which the alleged hyperæmia could be recognised with certainty.

Cysts and Tumours.—The choroid is liable to cysts and tumours of various kinds, the most important of which are sarcomatous or melanotic growths. The first indication of a tumour of the choroid is usually given by its lifting up the retina, and thus producing some disturbance of its contour. The result of such disturbance is that the part of the visual image which falls on the elevated portion of the retina will appear to be distorted. If the tumour be approximately central, near the yellow spot, the distortion thus produced will speedily force itself upon the attention even of the most unobservant; but, if the tumour be peripheral, the distortion, although obvious if looked for, may long remain unnoticed by the patient. Whenever it is complained of, a slight elevation of the corresponding portion of the retina will usually be discoverable by the ophthalmoscope, and it is possible that the colour of the subjacent portion of the choroid may be changed; as, for example, that a melanotic growth might reveal its probable nature, even at this early period, by the dark tint of the affected region. The diagnosis between a morbid growth and a detachment of the choroid will seldom present difficulty, since the latter is, as a rule, attended by diminished tension, while the growth, for obvious reasons, is almost of necessity attended by increased tension. If it increase in bulk, this increase of tension soon becomes more evident, and is, of course, accompanied by pain, as well as by other consequences of irritation which soon tend to conceal the details of the case. When a tumour commences at some point between the equator and the ciliary body, it may be visible through the pupil, either by focal illumination or by the ophthalmoscope, and it may attain some magnitude before vision is destroyed; but, in a general way, complete detachment of the retina is an early consequence of any choroidal growth. At the same time, the cornea is apt to become cloudy, and the transparency of the humours to be diminished by the presence of effusion; so that, except in quite an early stage, it will scarcely be possible to do more than determine, from the history of the symptoms and from the distension of the eyeball, that some form of morbid growth is inclosed within. If no treatment be employed, the further progress of the growth may either be to distend the eyeball as a whole, or to produce thinning and prominence of the sclera in some one direction. *See* ORBIT, Tumours of the.

Treatment.—The presence of a morbid growth in the choroid calls imperatively for enucleation of the eye, as soon as the diagnosis can be arrived at with certainty. The melanotic and sarcomatous tumours are prone not only to recurrence, but also to recurrence in other regions; and the best prospect of avoiding recurrence is afforded by early removal. Even cysts, and other harmless tumours, are certain causes of great pain and of loss of sight; and it is, generally speaking, impossible to arrive at certainty about the nature of a growth as long as it remains within the eye. When there is unquestionable malignancy, removal may not only afford much present relief from suffering, but may also delay, possibly for many years, the ultimate fatal issue.

If the enucleation of an eye which contains a malignant tumour of the choroid be too long delayed, the disease may have crept along the optic nerve, in which case it is manifest that speedy recurrence must be looked for. In performing enucleation for such a tumour, whether choroidal or retinal, it is always desirable to divide the nerve at the apex of the orbit instead of immediately behind the eyeball, and this may be done without difficulty by the employment of scissors with blades somewhat longer than those commonly used. Some surgeons have advised that, after the ordinary close section, the cut surface of the nerve should be examined, and that, if it shows any signs of the extension of any morbid process, the stump should be felt for with the finger, seized with strong toothed forceps, drawn forward, and cut off as far back as possible. It is better to anticipate such a proceeding by a deep section in the first instance, since the complete removal of the trunk of the optic nerve does not appear to diminish the fitness of the ultimate stump for carrying an artificial eye.

Coloboma.—Occasionally coloboma of the iris extends to the choroid. The deficiency in such cases is always downwards, and is sometimes continuous with that of the iris, sometimes separated from it by the intervention of an unbroken ring of ciliary body. The coloboma of the choroid is very variable in its width, and may either surround the circle of the optic nerve, or may stop short of its lower margin. The gap is seen with the ophthalmoscope as a white patch, of a generally oval outline, traversed by more or less wasted remains of the retina, some vessels of which are always distinguishable. Beneath the coloboma, the sclera is usually somewhat bulged out or staphylomatous; and the portion of retina which crosses it is usually insensitive, so that the deficiency is marked by a blind spot of corresponding position and magnitude. The precise appearances differ much in different cases; and no treatment is available in any of them.

R. Brudenell Carter.

CHOROID, Injuries of the.

—The choroid is liable to participate in many forms of injury to the eyeball, which will be noticed in the proper place, and in which its participation is likely to give rise to a larger amount of intraocular hæmorrhage than would otherwise occur. It is also liable to be ruptured by direct violence, without injury to the other tunics; as in cases in which the eye is struck by the rebound of a twig or by a tennis-ball. The rupture, in such circumstances, is always by *contre-coup*, and usually occurs near the entrance of the optic nerve. It is attended by hæmorrhage, by which, for a time, vision may be entirely obscured; but, in most instances, improvement of sight is to be expected when the blood is absorbed. As soon as an ophthalmoscope can be employed, the seat of the injury may usually be seen, as a linear or crescentic line or lines, more or less buried under coagula; and, as the coagula disappear, the whiteness of the sclera may be seen through the gap. If the injury encroaches upon the region of the yellow spot, central vision is likely to be practically destroyed; and, in other cases, in which it is at first but little affected, there is always some risk of subsequent impairment, due to changes in the nutrition of the retina, or to the contraction of scar-tissue.

Treatment.—When injury to the choroid is suspected, the only treatment called for is the use of atropine, of sedative lotions and fomentations, and complete rest of the sound eye, until the time comes at which the diagnosis can be made certain by the aid of the ophthalmoscope. Inflammatory complications, if they should arise, must be dealt with in the usual way; and no use of either eye should be permitted until the absorption of the effused blood is complete.

R. Brudenell Carter.

CHRONIC RHEUMATIC ARTHRITIS.

—An essentially chronic form of joint-disease, occurring in persons of rheumatic predisposition, affecting both small and large, one or many, articulations. It may begin insidiously with gradually increasing pain and swelling, or with more acute local symptoms. All the tissues of the joint are implicated by a chronic, and often progressive, inflammatory process, which appears to arise in the cartilages, and engages successively the synovial, bony, and ligamentous structures. Both sexes are affected, but females in larger proportion, and the disease may begin at any period, from early childhood onwards.

Cause.—Any conditions which determine the onset of symptoms commonly recognised as rheumatic, may lead to this disease. To state that all persons are not predisposed to rheumatism, is to affirm the existence in some of a habit of body peculiarly susceptible to the influences which excite it; and that such predisposition in the nature of diathetic proclivity is found in many individuals, is now believed by some of the best authorities, and the writer holds this opinion very strongly.

We have now to study the effects of certain influences upon those diathetically predisposed to rheumatic disease in general.

Foremost amongst these must be considered heredity. This counts for more than was formerly believed. Recent careful inquiries on this point furnish in most cases a clear history of rheumatic ailments in the ancestry. All circumstances provocative of catarrh must be reckoned as potent existing causes. Hence, residence in low-lying localities, on sodden soils, in ill-built or new houses, or on the ground floor, is frequently a cause. The disorder more certainly ensues upon exposure to moist conditions than to mere cold. Cold and dry climates appear little causative. It is unknown in the polar and in the equatorial regions.

Next must be mentioned all causes leading to exhaustion and enfeeblement of the nervous system, including especially an imperfect and innutrient dietary, overwork of body and mind, prolonged grief and anxiety. In women the frequency of onset after numerous pregnancies, hyperlactation, and menorrhagia is especially to be noted. Occupations such as those of laundry-women, bakers, and stokers specially affect those persons who are predisposed, the conditions obtaining in these cases being exposure to damp heat, and rapid alternations of temperature, together with vigorous bodily labour. Gardeners and out-door labourers are likewise exposed by their occupations to heavy muscular work and to wet, the former also to alternations of temperature when working under glass. The influence of moisture, apart from low temperature, is noteworthy in the cases of the very rheumatic peasantry in Ireland and the West Coast of Scotland, where, in addition to constant dampness of climate, habitation, and clothing, the dietetic conditions being also unsatisfactory, no severe cold is experienced. The influence of exposure to night air and of chill after fatigue is very marked.

Traumatism, undoubtedly, has much to do with the onset of rheumatic arthritis. Local injuries, seemingly trifling, also boils and whitlows, may set up the disease, which may thereafter spread to other articulations. Over-use of joints may also determine the onset of it. Rheumatic predisposition thus carries with it a special vulnerability. It has been taught that symmetrical invasion of joints alone indicates constitutional taint in this disease, but the writer believes that the local manifestations of the disorder are often equally significant of this.

The influence of diet has no etiological bearing on rheumatic arthritis, save only in respect of insufficiency and imperfection.

Amongst less well-recognised causes are chronic dysentery, and arterio-capillary fibrosis with contracted kidney.

Pathology.—The exact nosological position of this malady is not yet fully determined. Space forbids a review of all the opinions held at the present time. Those which commend themselves to the writer may be briefly expressed under two heads: (1) That this disease is a form of true rheumatism; and (2) That many of its characters seems to be dependent on lesion of the spinal cord, occurring thus specifically, or otherwise excited secondarily by peripheral irritation.

These views may be best considered together. The disease is one of several manifestations of the rheumatic branch of the basic arthritic diathesis. Gout is regarded as another branch of the parent stock. This position necessarily entails an indirect relation with all forms of diathetic arthritic disease, and, hence, the occurrence of chronic rheumatic arthritis is not antagonistic to the onset of other phases both of rheumatism and gout. The disease may therefore occur *specifically* in more or less grave form. Careful study of its etiology further indicates that in many cases the disorder is *symptomatic*, is 'a lesion common to several kinds of ailment' (Ord), capable of provocation by varied sources of peripheral irritation, amongst which may be enumerated injuries, over-use of joints, and, in particular, irritative conditions of the genitalia, as gonorrhœa, urethritis, ovario-uterine troubles, &c. Symptomatic arthritis, then, is regarded as a product of spinal tropho-neurosis. The nervous system is markedly implicated in the arthritic diathesis, and many of the features both of rheumatic and gouty disease point to the probability of there being a trophic centre, or centres, for the joints situated in the spinal marrow. Morbid or unstable conditions of these centres may result in a definite neurosis, which itself may be either inherited, acquired, or modified in particular instances.

The term 'rheumatic gout,' so often used as a synonym for this disease, the writer believes to be quite inapplicable save for a minority of cases where a true coalescence occurs. Gouty manifestations may supervene independently in the subjects of rheumatic arthritis, or may blend with rheumatic conditions; and in the course of many generations transitional modifications may occur and give rise to unusual forms of arthritis whose place is not always readily determinable. It is also probable that some of the irregular forms met with may be due to coalescence with other inherited diathetic states. Although there is an indirect relationship between rheumatism and gout, the two diseases are remarkably distinct from each other and from rheumatic arthritis.

It is further to be noted that coincidences of structural change after death do not imply identity of morbid states leading up to them. Thus, it has been shown that chronic gout may produce some of the changes in joints which were formerly attributed exclusively to rheumatic influence. It has been alleged that the rheumatic diathesis is universal. The writer denies this. Some individuals will never develop rheumatism in any form, however much exposed to exciting causes. Arthritic changes, not readily distinguishable from rheumatic disease, are met with in other mammals, and are also proved to have been existent in prehistoric periods.

The forms assumed in this disease are best described under the heads of acute, chronic, and irregular. The acute and general form is more common in young persons, is met with even in childhood, and especially in women, and then assumes the characters of a severe constitutional disease in more marked form. At the menopause, too, it is apt to be acute and rapidly progressive. The smaller joints, especially of the hands, suffer more in this form. The chronic variety is of more insidious origin, is met with more often after middle life and in the male sex, affecting more particularly larger, and often single joints. Many exceptional cases are, however, met with. In by far the majority of cases, no associated visceral lesions are found, and, in exceptional cases, these may be commonly traced to antecedent attacks of rheumatic fever. No indications of important changes have been hitherto discovered in the blood or in any of the secretions in this disease, although some degree of anæmia is not infrequent in advanced cases.

The morbid anatomy of this disease relates to changes in the synovial membrane, cartilages, bones, tendons, and ligaments composing the affected joints. The appearances vary extremely, according to the stage and duration of the disorder, and differ, too, in the several joints affected. Hydrarthrosis sometimes occurs in the early stages, due to effusion into the synovial sac. This may lead to much distension of the capsule, to undue mobility, to subluxation and even complete dislocation. Recovery from this relaxed condition is naturally slow and often imperfect. *Hydrops articuli* is most common in the knee, shoulder, and elbow. Stretching of the lateral ligaments occurs in the ginglymoid joints as a consequence. The fluid removed does not present extraordinary characters, clear or fatty epithelial cells being found as in normal synovia. The synovial membrane is red and thickened, with hypertrophied vascular tufts. At a later stage the fluid is absorbed, leaving the synovial membranes unduly thick, and the capsular ligaments altered to the consistence of intervertebral cartilage, and even at times bony in structure. *See* CHARCOT'S DISEASE.

The articular cartilages present marked changes. They early lose their brilliancy, and become of a dull, yellow colour. They soften and waste, becoming thin, villous, or fibrous in texture. In the knee the semilunar cartilages may entirely disappear, or, contrariwise, become much hypertrophied and even bony. In the phalangeal joints the centre of the articular cartilage becomes villous, eroded, and wasted, exposing the bone. The first stage consists in hypertrophy, with increase in the number of the cartilage-cells and formation of capsules around them. The primary capsules on the surface become globular and distended, and ultimately burst, discharging the free cells into the joint. The next layers of capsules tend to run into a linear series perpendicular to the surface, forming parallel rows of tubes filled with cells, exactly as met with in an ordinary process of intra-cartilaginous ossification. The proliferation of these cells results in formation of embryonic medullary tissue. The grooves which lodged the cells become filled with synovia or cellular débris. The matrix of the cartilage becomes linear, fibrous, and villous at the free end of the tissue. In some of these villi may be found swollen capsules, giving a club-shape to their extremities. Owing to friction in progress of the disease, the villi disappear, and the bone is exposed and in turn undergoes specific changes. Small nodules are formed at the edges of the cartilaginous investment—true ecchondroses, giving rise to the well-recognised nodosities of Haygarth and Heberden (nodular rheumatism). Later on these ossify.

At this time, in the case of the larger joints, the synovial fringes and ligaments are undergoing changes, dendritic growths occur, accompanied by newly-formed blood-vessels. These buds or growths likewise become cartilaginous, and sometimes pedunculated, tending to break off and form loose bodies in the joint. Cartilage corpuscles are sometimes normally found in synovial fringes. They may become truly bony. Ecchondroses, presenting these characters, are not significant only of chronic rheumatic arthritis, since they may be found in both strumous and gouty arthritis. They are necessitated by the anatomical features of the joint, and hence are common in arthritis of any kind, provided the process is sufficiently grave to induce them. The proliferating elements tend to accumulate at the edges of the joint, because these parts are invested by synovial membrane which includes them, and prevents their being shed into the cavity of the joint. Thus, cartilaginous overgrowths occur at any point covered by fibrous tissue or synovial membrane, and especially at the insertions of tendons and ligaments.

The bony changes are of two kinds, proliferating and atrophic, and both proceed together in different places. The former are seen in the ossification of ecchondroses, which begins at their bases. The newly-formed osteophytes undergo friction and eburnation on their surfaces. They resemble epiphysial exostoses in their structure, and are best seen in cases of *malum coxæ senile*, the head of the femur becoming expanded, and the neck of the bone curtailed. Around the acetabulum these bodies are abundantly thrown out, so that the size of the cavity is enlarged *pari passu* with its occupant. The knee-joint sometimes presents profound deformity from similar changes.

The atrophic changes are seen on the articular surface after the removal of the cartilage, and are related to the process of eburnation. The proliferating cells of the cartilage next the bone are believed to press on this texture and induce absorption of it, thus shedding themselves into the adjacent medullary spaces, and leading to conversion into, and incorporation with, new bone-corpuscles. In one or other of these ways a layer of dense bone is formed, which protects the delicate cancellous structure. Eburnation may also arise directly from inflammatory change in the cancellous tissue. On the eburnated surface may be found worn or wasted patches exposing spongy bone, and in most cases lines and grooves exist in the direction of motion, due to continued friction.

With all these profound changes it is remarkable that ankylosis is of extreme rarity. There may be complete immobility. This, however, is due not to fusion of the component structures, but to mechanical impediments, both in and around the joint. Destruction of the internal ligaments of an affected joint is common. The crucial ligaments in the knee may be disorganised, detached, or removed by absorption. The round ligament of the femur, and the tendon of the long head of the biceps within the shoulder-joint, may likewise be ruptured or removed. Bursal tumours also occur in the vicinity of affected joints.

The condition of the spinal cord, and of the nerves supplying affected joints, has not yet been studied. Researches in this direction are desirable. The heart and pericardium commonly escape associated inflammatory changes, but not always.

Symptoms and Diagnosis.—The early symptoms consist of pain, heat, stiffness, and swelling in the affected joints, with, sometimes, spasmodic startings of muscles. The pain is especially felt at night when the patient is warm in bed, or on awaking, also on resuming movements after repose. Grating and crackling sensation in the joints is both subjective and objective. The pain is of a burning or boring character, and may often be relieved by stretching and movement. In some cases no pain accompanies the progress of the disorder.

Deformities of varying extent now ensue, leading to knobby or knotty fingers, and more gross outlines in the larger joints. Temporary arrest of symptoms may occur, with recurrence under fresh provocation. A single joint may be affected, as in the case of the hip, leading often to diagnosis of sciatica or intracapsular fracture in elderly people. Patients are sensitive to climatic changes, and suffer from cold and damp, also, as the writer has found, in advanced cases, from extreme heat. As the disorder progresses, more and more crippling ensues, till the joint-movements become practically annulled by mechanical impediments. Spurious ankylosis is set up. Suppurative change is practically unknown. If many joints are severely involved, the patient becomes a complete invalid or bedridden, and frail health, with anæmia and languor (arthritic cachexia), is thenceforth established.

In the general form of the disease the joints are centripetally affected, and the upper limbs are commonly first attacked with more or less symmetry. The metacarpo-phalangeal joints of the thumb, fore and middle fingers are especially and early obnoxious, and the wrist, carpal, metacarpal, and phalangeal joints generally are the most frequently attacked.

Changes in the axis of the fingers arise, leading to eversion of them towards the ulnar side of the arm, and in young subjects varieties of flexion and extension of the several segments of the hand occur, as the result of spasmodic muscular contractions, which may also lead to subluxations. Axial distortions are by no means pathognomonic of this affection, being found occasionally in chronic gout. They are due to the influence of the extensor muscles of the wrist and fingers, the movements of abduction being more powerful than those of adduction. With late onset of the malady these latter deformities less frequently appear, doubtless because the muscular irritability is less, the parts more rigid, and the process less acute or less general. Slow wasting of muscles is common in the neighbourhood of the affected joints as a result of disuse. Rapid wasting occurs in acute forms of arthritis, and is probably of reflex nervous origin—a true neurotrophic lesion.

Spondylitis is happily not common, but must not be forgotten. The cervical and lumbar vertebræ suffer more than the dorsal, and the atlo-axial joints most of all, perhaps because motion is there more free. The temporo-maxillary joints are sometimes affected, and occasionally unilaterally, leading to remarkable deformity. Eburnation may occur here. The lower limbs often suffer symmetrically, motion being restricted at the hips, while the thigh is bent on the pelvis, and the leg on the thigh. The femur projects on the tibia, the external condyle being prominent, and the patella, usually enlarged, resting upon it. The head of the fibula may project. At the knee there may be spurious ankylosis; at the tibio-tarsal joint more complete interlocking, the foot being either adducted or abducted, simulating respectively pes valgus or equino-varus. The great toe is commonly everted, and may overlap the others.

The diagnosis in the general form of the disease may be difficult in an early stage, where many joints have been acutely affected and rheumatic fever has been suspected. Many cases begin as ordinary acute rheumatism, and, not yielding to treatment, linger on with progressive deformity and pain. The diagnosis may thus be impossible at the outset, It must also be made from the polyarthritic form of gout, with which it is sometimes confounded when no uratic deposits are obvious. The latter must be sought especially in the cartilages. Evidence in favour of gout will be found by inquiry into habits as to diet, and as to heredity, by examination of the urine and of the blood for uric acid. Associated lead-taint will declare for gout. A history of previous articular attacks in a great toe, or knee, followed by desquamation of cuticle; of inability to take malt liquors, or certain articles of food, without bringing on, sometimes promptly, joint-pains, points to gout.

Treatment.—More agreement prevails on this point than on the question of nosology. In brief, it may be affirmed that what is good for rheumatic manifestations anywhere is good for chronic rheumatic arthritis. The principles of treatment must vary somewhat with the exciting and determining causes in each case. Attention must be paid to the existence of any cross-taint. Little good will be gained till a better condition of general nutrition, and of the nervous health, is secured. All causes of depression and exhaustion must be removed. A good and varied dietary is essential, including free use of foods containing sulphur, such as onions, cruciferous vegetables, and especially mustard. Fats are of value, and cod-liver oil ranks high as a remedial agent. Animal food is conspicuously absent from the diet of the worst sufferers in Ireland and the western islands, and potatoes constitute the main vegetable support, with a scant allowance of milk. Fish is desirable, especially when fresh. A moderate allowance of malt liquor or of good wine with one meal daily, is generally advisable. Residence should be sought in a sheltered, dry, and somewhat elevated locality. It is probable that the disease would often be arrested if tropical, or semi-tropical, residence were secured for a few winters in an early stage. High value attaches to early treatment. Rest is necessary when there is much local pain, and splints and cotton wool may be required. Belladonna, opium, camphor, or soap liniments are the best applications in the acute stage. Where there is much effusion, thecal or other, iodine or cantharidine liniment may be applied, care being taken never to encircle any joint completely. Acute pain that will not at once yield to anodyne applications may be relieved by leeching or wet-cupping.

The medicinal treatment of the acute stages consists of salicylate of soda in twenty-grain doses every six hours, or of iodide of potassium and quinine given together in the respective proportions of five grains and one or two grains, made soluble with one or two minims of dilute sulphuric acid. Quinine with citrate of potash is also of value. Small doses of compound soap pill may be given by day to secure repose, or ten grains of Dover's powder each night, if necessary.

In chronic conditions the following drugs are found most useful. Cod-liver oil, iodide of potassium pushed to ten or fifteen grains for a dose, arsenic in full doses, iron, and sulphur. Lemon juice has been of proved service in some cases. Guaiacum, sulphur, and acid tartrate of potass, in the form of the 'Chelsea Pensioner' electuary has been found of value as a local application. Flannel soaked in cod-liver oil is a good remedy for the aged poor in cases of languid circulation with dry skin. Exercise is of much importance to secure the best relations between the altered articulating surfaces, to anticipate spurious ankylosis, and so preserve the functions of the limbs. Skilful treatment by shampooing and massage, and by electricity, has a prominent place, and the resources of the best British and foreign warm sulphurous and saline spas are of high value. In this country the waters of Bath, Buxton, Harrogate, Strathpeffer, Woodhall, and Llandrindod are in the highest repute; while on the Continent those of Aix-la-Chapelle, Aix-les-Bains, Baréges, Bourboule, Franzensbad, Gastein, Kreuznach, Pyrmont, Teplitz, Wiesbaden, and Wildbad, are well adapted for resort. The arrangements at Aix-les-Bains are admirably adapted for successful treatment. Several seasons in succession should be spent at one or more of these spas in order to secure full benefit. Hot sulphur douching is of proved utility. Peat-baths and hot sand applied locally are available remedies at some of the foreign spas. The pains and weariness of the later stages of the disease are best met by opium in small doses, and by bromide of potassium.

Well-adapted support to joints by soap plaster spread on thick buckskin is very useful for the knees, and daily use of the flesh-brush is advisable. Woollen underclothing must be worn all the year through. Elderly patients should get daily exercise in the sun, whenever possible, and all exposure to draughts and damp must be carefully avoided. The malady is practically incurable in the old, and early treatment of all cases is imperative if arrest of it is sought. The importance of following up each case of acute rheumatism, till perfect health is restored, is obvious.

Dyce Duckworth.

CHYLURIA. — *Synonyms*: Chylous Urine; Hæmato-chyluria.

Definition.—A milky appearance of the urine, due to the presence of suspended fatty matter having the characters of chyle, and generally occurring in persons infested by a nematoid worm, the *filaria sanguinis hominis.*

Cause.—Chyluria is essentially a disease of tropical and sub-tropical climates, but occasionally it occurs in persons who have never left temperate regions, where the disease does not prevail endemically. Whilst the immediate cause is probably the same in these two classes of cases, the remote cause most likely differs, as will be made more apparent under the head of Pathology. Though the disease does occur occasionally in those who have never resided in the tropics, most of the cases observed and recorded in this country have been imported from regions where the disease is endemic. Chyluria occurs in both sexes, perhaps slightly more frequently among females, and at all ages. The remote cause of the endemic cases is the infection of the patient with the *filaria sanguinis hominis.* Violent exercise or exertion sometimes determines the outbreak of the disease.

Geographical Distribution.—The disease is endemic in the Mauritius, Isle of Bourbon, West Indies, the Brazils, Egypt, India, China, and Australia; the range probably, as stated by Lewis, being limited by about 30° south, and 30° north latitude.

Pathology. — The analyses of many eminent chemists show that all the elements of chyle are present in the urine. Though the proportion of the main constituents of chyle — fatty and albuminoid — differ in many cases from the proportion in which they occur in chyle, this discrepancy is of doubtful significance, since the examinations of both chyle and urine have not been studied, with sufficiently exact reference to the ingestion and quality of food, to admit of accurate comparison. Vandyke Carter has shown that the correspondence may be close.

In order to understand how chyluria may be brought about, it is necessary to glance briefly at chylous exudations generally. In the first place, there have been recorded cases of chylous ascites, in which ascitic collections have had a milky appearance, suggesting, both from their appearance and chemical qualities, an admixture of chyle with serous effusion. These have been proved in some instances to be due to tumours pressing on the thoracic duct or lacteals (Hughes, Ormerod, Wilks.) In consequence of such pressure the lacteals have become distended, dilated, and varicose, and rupture or leakage has followed, so that chyle has become commingled with the dropsical effusion due to pressure on the trunk or branches of the portal vein. These cases are very important, as supplying anatomical proof that the milky appearance of the exudation was caused by admixture of chyle with the serous fluid. Winkel has recorded a case of chylous ascites in a woman who came from Surinam, and in which he thought he detected filaria in the fluid. His description, however, leaves this point doubtful. Quineke has recorded a case of milky effusion into one pleural cavity, probably due to rupture of the thoracic duct by injury. Milky fluid was also found in this case in the peritoneal cavity, and was ascribed to anastomosis between the pleural and peritoneal lymphatics.

Cases have been recorded in this country of encysted hydroceles in which the fluid has been milky. Such cases appear not to be uncommon in the regions in which chyluria prevails. They have been shown to be associated with the presence of filaria in the milky fluid and in the blood, and are attributed to rupture of congested lymphatics into the tunica vaginalis. Next there occur a series of cases in which milky fluid escapes from fistulæ, or eruptions in some part of the surface of the body. In the majority of such cases lymphatic obstruction can be easily demonstrated, enlarged and hardened glands, or varicose lymphatic trunks, being apparent. In these cases fluid escapes, often in very large quantities, from the affected parts, spontaneously, or as the result of accidental or intentional injury. The fluid has, in some cases, the qualities of lymph, containing albumin, fibrin, and lymph-corpuscles. But in many cases, at some period of their progress, and in other cases at all times, the fluid has a milky appearance, and chemical examination has shown it to contain all the constituents of chyle. Such local discharges of lymphous or chylous fluid are generally situated on the trunk or at the proximal extremities of the limbs, parts at which regurgitation from obstructed and dilated lacteals would be relatively easy. Cases of this kind, known as 'lymph-scrotum,' 'varix lymphaticus,' or 'nævoid elephantiasis,' are very common in countries where chyluria prevails, occasionally co-exist with chyluria, and have been shown to be connected with filarial infection, either local or general. At the same time cases have been recorded in persons who have never left this country (Buchanan, Roberts, &c.), so that it is not directly on filarial infection that such a condition necessarily depends, but on some process which is usually initiated by filarial infection, but may be brought about by other means.

It is thus seen that chylous exudations are generally associated with obstruction or injury to lacteals or lymphatics, and that the milky appearance has, in some of the instances, undoubtedly been due to the presence of chyle, justifying the term chylous applied to them generally. These considerations would suggest the conclusion that chyluria is of a similar nature—a conclusion which is supported by the characters of the urine and its frequent association with one of the other conditions dependent on lymphatic obstruction, for it is unlikely that such frequently associated conditions would have a different causation. This view, that chyluria is dependent on admixture of chyle with the urine in a direct manner, by means of a fistulous communication between the lymphatics and lacteals in the lumbar region and the pelvis of the kidney, ureter, or bladder, is that advanced by Dr. Vandyke Carter, in 1862, previously to the discovery of the connection of the disease with filariæ in the blood and lymphatics.

It has since been established by a number of observers (1), that the endemicity of chyluria and filarial infection are the same; (2), that the habitat of the parent filariæ is the lymphatic system; (3), that in filarial-inhabited lymphatics there is a tendency to obstruction of the trunk of the lymphatic or of the glands to which it leads, with varicose dilatations and escape of the contents of the lymphatics, consequent upon such obstruction; (4), in a case recorded by the writer, the renal, lumbar, and iliac lymphatics were in a very varicose condition.

Dr. Patrick Manson has offered an explanation of the pathology of the various lesions associated with the presence of the filaria sanguinis hominis in the lymphatics and blood-vessels, having the merit of uniting a number of frequently associated conditions, which, whilst differing much in outward appearance, have the same geographical distribution. If his explanation appear fanciful and farfetched, it must be remembered that no one has done more to unravel the mystery pervading the subject, and that many of the phenomena connected with filarial infection are so strange as to seem incredible to those who have not studied the matter.

In ordinary circumstances the embryos of the parent filariæ situated in the lymphatic trunks are born with their chorional envelopes stretched, and are then of such dimensions as to be able to traverse the smallest capillaries (*see* FILARIA SANGUINIS HOMINIS). It has, however, been shown that occasionally ova escape from the female parent. The ova, with their unextended chorional envelope, are from five to seven times greater in their smallest diameter than the outstretched embryos, and their size, and perhaps absence of power of self-movement, render them too large to pass the delicate meshes of the lymphatic glands, where, acting as emboli, they plug the lymph-channel, and dam up the lymph or chyle. 'There will then be complete stasis in this particular vessel, as far back as the first anastomosing lymphatic. Along this the current will now pass, carrying with it other ova; these in their turn will be arrested at the first gland they reach. And this process of embolism, stasis of lymph, diversion of current into anastomosis, will go on until the whole of the lymphatic glands, directly or indirectly connected with the vessel into which the parent parasite ejects her ova, are rendered impervious, provided the supply of embolic ova is sufficient, kept up long enough, or renewed from time to time.' (Manson.)

If the *aborting parent* is in the lymphatic trunk of the pelvic or lumbar region, should the stasis caused by the ova involve the lymphatics of the kidneys, ureters, or bladder, chyluria may result, owing to a nævoid condition of these lymphatics discharging themselves into the urinary tract. If the discharge comes from a lymphatic reservoir, the result will be lymphous urine; if from a lacteal or from a lymphatic into which chyle has *regurgitated*, chyluria will result. Irregular pouchings and collections, which, when sufficiently distended, render the lymphatic valves incompetent, may be one of the factors in producing the irregularities in the characters of the urine in such cases. The essence of Manson's pathology is—obstruction of lymphatic trunks, stasis, dilatation of tributary lymphatics, rupture, and escape of contents. Whilst in the endemic cases, abortion of the female parasite may be the usual cause of the lymphatic obstruction that leads to the varicose condition and rupture of the lymphatics, *any other condition that leads to such obstruction* may be expected to be followed by similar results. It seems, moreover, probable to the writer that, even in filarial cases, it is not essential to invoke the premature escape of ova, but that the parent filariæ may by their presence excite inflammation of lymphatic trunks, and thus give rise to stasis. In non-filarial cases inflammation (from which it is known the lymphatics elsewhere are by no means exempt) excited by other causes, may be the explanation of the lymphatic obstruction; just as elephantiasis of the lower extremities is sometimes caused in persons who have never been abroad, by injuries that lead to inflammation and obliteration of the lymphatic trunks of the thigh. Anatomical proof is still wanting as to where the communication is established between the lymphatic system and the urinary tract. In a case recorded by the writer, the iliac, lumbar, and renal lymphatics were greatly dilated.

In a case recorded by Dr. W. Roberts, the communication was probably in the bladder, and the condition was ascribed to a nævoid state of the cutaneous and subcutaneous lymphatics, some of the varicose enlargements, on the surface of the skin, rupturing and discharging their contents externally, whilst others discharged their contents into the bladder. One other explanation has been put forward by Claude Bernard and Ch. Robin, viz. that a piarrhæmic condition of the blood is present, and that the kidneys merely eliminate the fatty matter. Robin has further suggested that this state of the blood, natural after meals, is rendered more or less permanent by some derangement of the digestive organs, especially the liver, by the filaria sanguinis hominis. But whilst some analyses of the blood have shown fatty matter in excess, others, as those by Bence Jones and Crevaux, have shown that no such excess of fat in the blood has existed in cases of chyluria. Moreover, as Dr. Roberts writes, 'it is incredible that blood-albumin and fibrin should pass from the blood into the urine through the kidneys, without being accompanied by casts of the uriniferous tubes.'

In cases in which post-mortem examinations have been made, no structural alterations have been found in the kidneys. Filariæ have been found in the blood-vessels, arteries, and veins, to their minutest ramifications. Careful examinations and injections of the lymphatics are much to be desired where the opportunity is afforded.

Symptoms.—There are usually no proper premonitory symptoms. Sometimes the disease sets in insidiously, but more usually it makes its appearance abruptly, the first indication of the malady being that the urine is noticed to have a milky appearance. Sometimes the attack is ushered in with hæmaturia, and in many cases hæmaturia is present to a greater degree than is accounted for by mere lymphatic, or lacteally-developed, blood-corpuscles. This admixture with blood, which has led some to designate the disease 'hæmato-chyluria,' appears to be more common in Egypt, the Brazils, and the West Indies than in the cases of the disease seen in India and China. Lewis suggests that it may be due to some specific difference in the parasites causing the urinary disorder in the different countries.

In one or other of these ways, the urine acquires a milky appearance. There may be few or no general symptoms accompanying the chyluria, but local symptoms, such as pain or uneasiness across the loins, are sometimes complained of, pain may be felt along the ureters and in the bladder, and, in the male, in the perineum. This is especially the case where coagula form in the bladder, when micturition may be impeded or obstructed. In such cases, in the male, long cylindrical coagula, moulded in the urethra, are sometimes passed with relief to the obstruction. There are sometimes marked debility, depression, and wasting; but the chyluria may occur with the appearance and feeling of perfect health. There may co-exist with the chyluria, lymph-scrotum, and elephantiasis of the scrotum or lower extremities, with chylous discharges from the surface of the body. In filarial cases, irregular attacks of pyrexia are prone to occur—'filarial' or 'elephantoid fever.' These feverish attacks, sometimes mistaken for ague, differ from the latter in the irregularity of the fever and intermissions. In most cases the blood taken from a prick at any part of the surface of the body is found to contain embryo filariæ in an active moving condition. In order to detect their presence, the examination should be made at *night*, on account of their periodical appearance in, and disappearance from, the circulation. *See* FILARIA SANGUINIS HOMINIS.

Characters of the Urine.—The urine sometimes looks like milk, sometimes like a mixture of milk and blood. It has a sweet, and sometimes a milk-like, or whey-like smell, when freshly passed, especially on being warmed, but it soon becomes fœtid. When allowed to stand, a cream-like layer often rises to the surface, and the remainder of the fluid, after a short interval, sets into a blancmange-like jelly, which, after remaining in this condition for a few hours, spontaneously disintegrates, a few filmy coagula, containing blood-corpuscles, floating in the fluid, and a deposit, looking like blood, falls to the bottom of the vessel. The quantity of urine is almost invariably increased to 70, 80, or 100 ounces in the twenty-four hours. The specific gravity is generally below normal. The reaction is neutral or faintly alkaline. The ordinary constituents of urine are present, generally in natural proportions, except the water, which is increased. Albumin is always present, generally in considerable quantity, and is coagulated by heat, nitric and picric acids. Peptones, and a trace of indican have been found in the urine (Ralfe). Sugar is absent in uncomplicated cases. Casein has not been found. The clot has the property possessed by fibrin, of decomposing peroxide of hydrogen with effervescence. When the milky urine is shaken with ether in a test-tube, the fatty matter rises to the surface, leaving the urine clear or slightly opalescent. The ethereal extract, on evaporation, yields a solid or oily uncrystallisable fat, partly saponifiable, resembling that found in the blood.

In some cases the urine is *lymphous* rather than chylous; that is, it contains albumin and coagulates spontaneously; but the fat is absent, together with the opaque milky appearance which depends thereon. The coagulum in lymphous urine resembles calves-foot or currant jelly (Roberts).

Many analyses of the urine have been made in chyluria. The following by Brieger of the night urine are valuable for their completeness:—

	Maximum in 100 parts	Minimum in 100 parts
Fats	0·725	0·06
Albumins . . .	0·798	0·581
Urea	3·4	3·7
Uric acid . . .	0·03	0·03
Sodium chloride . .	1·7	1·4
Sulphates . . .	0·22	0·23
Quantity of urine .	400 cc.	300 cc.
Specific gravity . .	1·016	1·025

Microscopical examination of chylous urine shows finely granular, fatty matter (molecular basis of chyle), oil-globules in some, but not in all, cases, especially in the creamy layer that rises to the surface; corpuscles resembling the white corpuscles of the blood and lymph; red blood-corpuscles of various sizes and stages of development;

and, in most cases, embryo filariæ. As a rule, with scarcely any exceptions, no renal casts are present. Occasionally urinary crystals, as oxalate of lime, are found, and, when the urine has been kept for any time, putrefactive bacteria will probably be discovered. The embryo filariæ are found alive and dead. They probably do not live long in the urine when passed, owing to its decomposition. In order to detect them, any portion of clot which is blood-coloured should be placed on a slide and examined, or the coagula in the urine may be broken down by stirring, and the deposit removed after subsidence, but they also occur in the free deposit in some instances.

The degree of milkiness of the urine varies in different cases, and often in the same case at different times. In most cases it is much more chylous after meals than at other times, but this does not obtain in all. In some cases the urine is most chylous in the daytime, but in others, that passed on rising in the morning is most milky. In some cases, rest, position, and exercise appear to influence its characters; but, as Dr. Roberts writes, irregularities in regard to meals, exercise, and rest are inextricably contradictory.

Progress and Duration.—In some cases the disease persists with little variation for years. In the majority of cases, after lasting an indefinite time, it spontaneously ceases, or appears to yield to treatment; but after the patient has remained free from the malady for months or years, it becomes re-established without any explanation of its recurrence. The urine has been known to be milky on one or two occasions only, and its chylous character has persisted for upwards of fifty years. The intermissions have sometimes appeared to be due to independent illnesses or shock, but in other cases no such influence could be traced. In the majority of fatal cases, death has been brought about by intercurrent diseases. Dr. T. Lewis remarks: 'Patients, in apparently good health otherwise, have been known to die very unexpectedly from no recognised acute disorder.' The case recorded by the writer in the *Pathological Society's Transactions* affords a probable explanation of such terminations, the fatal issue in this instance apparently being due to the local consequences of the death of the parent filariæ in the abdominal and thoracic lymphatics.

Diagnosis.—As a rule no difficulty is experienced in the recognition of the disease, but the practitioner must bear in mind the possibility of the intentional or accidental addition of milk to the urine after it has been passed. In true chyluria, the urine always contains albumin and fibrin. Owing to coagulation of the urine within the bladder, micturition may be interfered with, and the case come under the care of the surgeon on this account. In one case under the care of the writer there had been cystitis at the commencement of the attack. Whilst the disease is usually to be traced to filarial infection, it must be borne in mind that chyluria may continue in cases where filariæ have ceased to be present in the blood or urine, and that it does occasionally occur in persons in whom there is no reason to suppose that they have ever existed.

Prognosis.—The prognosis will have been gathered from the account of the progress and duration of the disease. The irregularity of its course, and its liability to recurrence, render the prognosis quite uncertain in any individual instance. In cases in which filariæ are found in the blood, the possibility, however remote, of a rapidly fatal termination must be remembered.

Treatment.—No plan of treatment offers any certainty of cure. Whilst rest in the recumbent position is sometimes of decided benefit, it is too uncertain in its effect, and too irksome to the patient, who often feels well in other respects, to be always willingly submitted to. It is worth trying, however, when practicable. Dietetic treatment—the exclusion of all fatty substances—may lessen the milkiness of the urine, but will scarcely benefit the patient. No drug exercises a positively specific influence, though the mangrove bark (Rhizophora racemosa), and the seeds of Nigella sativa (a constituent of curries), enjoy local reputations. Theoretically, antiparasitic remedies appear to be indicated in cases where filariæ are found to be present; but in the first place, no remedy of this class appears to have been successfully employed, and in the second place it is not certain that the disease would be cured even if the parasites that initiated the chyluria could be destroyed, for, as already stated, the malady sometimes persists when filariæ which were present at one stage of the disease have disappeared from the blood and urine. Moreover, some good authorities are of opinion that the death of the parent worms in the lymphatics, if it could be accomplished, is by no means devoid of danger. Astringents, mineral and vegetable, are sometimes of at least temporary benefit, especially perchloride of iron in cases where there is much anæmia, and gallic acid. The latter is chiefly trusted to in India, and may be given in doses of one or two drachms a day. Iodide of potassium has also appeared of occasional service. The writer has seen in three cases very striking benefit from benzoate of soda, in doses of from twenty grains to two drachms three times a day. Under this treatment the milkiness of the urine has been greatly diminished, or has disappeared; and, what is of importance, coagula have ceased to form in the bladder. He has not, however, been able to follow out any case for a sufficient period to ascertain how long these good effects are maintained. *See* Filaria; Elephantiasis Arabum; Lymph-scrotum.

Stephen Mackenzie.

CICATRICES, Pathological Conditions of.—It is intended in this article to deal with the deformities caused by cicatrices, and with the abnormal conditions and pathological affections of scar-tissue.

Discolouration of Scars.—A cicatrix may become discoloured through the inclusion within its tissue of some foreign material. The best known instances of this staining are presented by scars formed after gunpowder injuries, and by the corneal opacity that sometimes follows the application of nitrate of silver to an ulcer of the cornea. It has been asserted by Nélaton that an indelible stain may be caused by the application of black court-plaster to a small healing wound.

In old cases of chronic and varicose ulceration of the leg the scar and surrounding skin are often marked on the surface by patches of deep brown pigmentation. The scars formed on the healing of syphilitic ulcers present for a time a coppery-red colour, and subsequently become unnaturally pale. Large strumous ulcers are replaced by uneven scars of an unsightly livid tint, and traversed by prominent bands.

Deformed Scars.—The scar of an ulcer associated with necrosis or caries of bone is usually very dense, depressed, and closely connected with the previously diseased bone, and, when present in some exposed region, as on the forehead, causes much disfigurement. Extensive cicatrices of long standing, which have been formed over the inner surface of the tibia after necrosis, often become very dense and of almost cartilaginous hardness. As good instances of the deformity and mischief likely to be caused by adherent scars may be mentioned cicatricial ectropion after bone-disease, and cicatricial closure of the jaws.

The so-called *exuberant* or *deformed cicatrix* due to excessive formation of scar-tissue is a frequent result of tardiness in the healing of a granulating surface. It is very often met with after scrofulous and lupoid ulceration and after a deep burn. Under this heading may be ranged the numerous varieties of hypertrophied scar, from the small lumpy growths mentioned by Sir James Paget, as occasionally observed after the operation for hare-lip and a vertical wound through an eyelid, to the thickened masses closely resembling keloid growths which are sometimes formed over large and multiple cicatrices.

Cicatricial Deformities.—Deformities caused by dense retractile cicatrices occur most frequently after very severe and extensive burns. The following are the different forms of cicatrix by which deformity may be produced:—(1) The *broad and expanded cicatrix* met with in most instances in front of the neck. This usually consists in a thick parchment-like membrane of a light colour, and mottled on its surface with yellow or brown spots. The surface is uneven and marked by intersecting ridges. In consequence of the retractile action of this scar on the movable skin of the face, the lower lip and the lower eyelids are dragged downwards. The lower jaw is also depressed towards the top of the sternum; and in old cases the shape of this bone is much altered, and the front teeth project forwards. Among the many troublesome results of such a condition is a constant flow of saliva, causing irritation and superficial ulceration of the scar. (2) The *narrow cicatrix* extending like a tight cord or riband from one part of the surface to another, and forming the so-called 'vicious bridle.' This is met with most frequently in the upper extremity, extending across the axilla to the arm, or from the arm to the forearm in front of the elbow. (3) A very frequent form of cicatricial deformity is that caused by the *scarring of adhesions* formed between contiguous and approximated parts. Cases have been observed of adhesion of the scrotum to the inner surface of the thigh, of the mamma to the front of the chest, of the pinna to the side of the head, and, after scalding, of the inner surface of the cheek to the gums. The most frequent instances, however, of this deformity are the adhesions of fingers and of toes after burns of the extremities. (4) The *depressed cicatrix* which is the result in most instances of a severe burn, which, without involving much of the surface, has extended deeply into the limb. In this form of cicatrix the skin may be tightly bound down to the surface of a bone, and the muscular and other soft parts be much constricted. *Cicatricial contraction*, extending in some instances to almost *complete obliteration of a natural orifice*, as the mouth, anterior nares, and orbital aperture, is the result partly of adhesion of the burnt or ulcerated margins of the opening, and partly of concentric retraction of the surrounding scar.

In the *treatment* of cicatricial deformity the surgeon may either practise *extension* or *compression* of the scar, or these two methods combined, or have recourse to some cutting operation. If properly applied in suitable cases, extension tends to elongate and unfold the cicatrix, and compression to cause absorption of some of the special retractile material of the cicatricial tissue. Each method must be applied with great care, and demands, as a condition of success, much patience and perseverance. If the extension be used with sudden force the cicatrix may be torn, and serious inflammatory mischief, with ulceration, be set up. The agents used in extension are a specially devised collar for a large cicatrix in front of the neck, hinged splints moved by screws or cogwheels for cicatricial bands of the upper extremity, and weights in the rare instances of contraction from scars over the hip or knee. Compression is best applied by strips of plaster, and, over these, elastic bandaging.

The following are the principal methods of operative treatment:—(1) *Simple subcutaneous dissection*, by which the adhesions of a broad cicatrix to subjacent soft parts are divided. (2) *Incision*, either by one single cut across the cicatrix, or by a number of small cuts, the distorted parts being at once restored, as far as possible, to their normal position, and one large open surface or several small wounds being formed. (3) *Division of the cicatrix*, relief of the distortion, and immediate closing of the wound by bringing its edges together in a line at right angles to that taken by the knife. (4) *Excision of the scar*, with approximation of the edges of the gaping wound by interrupted or quilled sutures. (5) *Loosening of cicatrix*, by incision of sound skin, either above or below, and by subcutaneous dissection. (6) *Plastic operations*, consisting in either simple division or complete removal of the cicatrix, and in completely or partially covering the open surface thus formed with a flap of skin taken from a contiguous or remote part of the surface of the body.

The indications and the special advantages of each of the above-mentioned methods of treatment may be thus briefly stated.

Mechanical extension associated with direct pressure by means of elastic bandaging and plaster, and with occasional manipulation of the cicatrix, will produce partial absorption of the retractile tissue, render it more pliant, elongate the bands, and, consequently, favour the restoration of distorted parts to their normal position and mobility. This non-operative treatment is applicable to a large class of cases. Most broad and membranous cicatrices which are not very thick, and not closely attached by their under surfaces to fasciæ, muscle, or bone, are more or less amenable to long-continued stretching and pressure. Where extension is applied, an essential condition of success is the presence of sound and dry integument above and below the cicatrix, for the extremities of the stretching apparatus to rest upon.

Simple incision or division of a large cicatrix produces immediate relief, which, however, does not remain permanent. The large open surface contracts as it heals, and the temporarily relaxed parts are gradually brought to their former abnormal position.

The method of multiple small incisions acts very effectually in many cases, but generally in those which are as readily amenable to non-operative treatment.

Excision is a valuable method in cases of small scars, and of long, narrow, tendon-like bands that are not very salient, but is ineffective and dangerous in any case of deformity produced by a thick and broad cicatrix.

Incision, associated with submembranous dissection and partial detachment of the cicatrix, generally produces great and marked relief, and, in some instances, complete cure. A very prolonged and wearisome course of after-treatment, however, is necessary in order to control the retractile action of the newly-formed cicatrix, and to prevent renewal of the deformity.

Autoplasty, when well-planned and successfully performed, is less likely than any other method to be followed by any return of the deformity, as the retractile structure is replaced by a flap of supple and extensile skin. This method may be applied with good prospect of success to many cases in which the cicatricial deformity is too severe and extensive to be treated effectually in any other way. *See* CHEILOPLASTY.

PAINFUL SCARS.—As a general rule the surface of a sound scar is much less sensitive than that of the adjacent integument, and the thickened scars and the tight and dense cicatricial bands, formed after severe burns, are usually quite insensitive. The subjects of some large scars, however, and especially of extended patches of thin and pale scar-tissue on the back and shoulders, often complain of itching or burning sensations over the seat of the old injury, but most intense near the junction of the cicatricial tissue with the healthy skin. In most instances these attacks come on very irregularly, and are most severe during damp weather.

A more troublesome affection is what has been called *neuralgia of scar*. This is characterised by severe burning pain, which, in some cases, is limited to the scar, and in others radiates along the nerve-trunks of the affected limb or region. These neuralgic pains, which may be either paroxysmal or persistent, occur most frequently in cases of irritable stump, and in tense and depressed scars. When persistent, the pain is very often due to squeezing or stretching of the extremity of a nerve by retractile cicatricial tissue, or to compression of the nerve between bone and a tense and depressed scar. In many cases, however, of neuralgic scar, especially those in which the pains are paroxysmal, the cause of the affection is very obscure. *See* STUMPS.

The itching sensations in scars, often so troublesome during changes in weather, are not as a rule very amenable to treatment. In some cases warmth, in others cold, gives relief. When painful, the scarred surface should be covered by a layer of some dry, warm, and very soft material, such as cotton-wool. A broad, painful scar, if much exposed to the friction of underclothing, should be protected by simple plaster or emplastrum opii. In cases of more severe cicatricial pains, the local application of chloroform, or of vinum opii and glycerine, or a subcutaneous injection of morphia, will afford some relief, trial being made of quinine in large doses during any attack of a paroxysmal character. In the treatment of neuralgic pains causing much and constant suffering, attempts may be made to effect a cure by cauterising or excising the scar if small; by dividing subcutaneously any adhesions that may exist between the scar and bone or other deep parts; by neurectomy; by nerve-stretching, or by excision of the extremity of the affected nerve.

ULCERATION. — Cicatricial structure, though imperfectly organised and not freely supplied with blood, seldom ulcerates, except it be subjected to much violence or continuous irritation; or, together with the surrounding normal structures, it be involved in some local inflammatory action, or some disturbance of the circulation. The most frequent examples of cicatricial ulceration are the breaking down of the scar of a chronic ulcer of the leg, associated with more or less varicosity, and the rapid disappearance of a very recent and thin scar under the influence of an attack of erysipelatous inflammation. During the healing of an extensive burn there is a constant tendency in the newly-formed scar to inflame and ulcerate. The scars most liable to ulceration are those which adhere to bone, and those tightly stretched in the form of prominent bands between two segments of a limb. A slight laceration, or a scratch even, of a large and stretched scar may become the starting-point of extensive ulceration.

In cases of ulceration of scar-tissue, an endeavour having been made to remove all sources of further irritation, the affected part should be kept at rest, and the open surface be treated as an ordinary wound or ulcer.

EPIDERMIC GROWTHS. — Simple warts sometimes grow from cicatricial tissue, particularly of a depressed scar between two bulging flaps of a stump. These are generally the result of inattention to cleanliness. Epidermic growths are occasionally seen on the scars that result from cauterisation of the skin, where they form small conical or pyramidal eminences, resembling in appearance ordinary corns. Sometimes a long thin horn grows from the surface of a scar. Hutin related a case in which a horn two inches in length had grown from a scar produced by the actual cautery. A portion of the cicatricial tissue extended far into the centre of this horn, which was vascular and tender on section.

KELOID.—Keloid growth of scar-tissue (*keloid of Addison, false or cicatricial keloid*) usually presents itself as a firm, elevated tumour, with rounded and sometimes overhanging margins, from which spur-like processes pass into the surrounding healthy skin. The surface is smooth and glossy, in some cases of a red or pink colour, in others quite white. A few small vessels may usually be seen running over the growth, and some thin hairs may be scattered over its surface. The tumour, when large, is usually marked in its central parts by one or more distinct depressions. It is slightly tender when handled, and in some cases, particularly at an early stage of growth, is the seat of itching or stinging sensations. Keloid consists in a circumscribed tumour, the cut structure of which has the appearance of a firm fibroma, and presents under the microscope very closely packed bands of fibrous tissue, running for the most part parallel to the surface of the growth. It may be developed in any variety of cicatrix, from the extensive and thick bands formed after a severe burn, to the almost imperceptible mark of a leech-bite. It has been observed in the scars of small-pox, herpes zoster, acne, and syphilis, and may come on, it has been stated, in the seat of a blister, or even after a contusion without any lesion of the epidermis. A case has been recorded by Verneuil in which the conjunctivæ of both eyes were affected with small keloid growths formed after the caustic action of strong sulphuric acid. The most frequent starting-points are the cicatrices of syphilitic ulcers, of burns, and of wounds caused by flogging. There seems to be a marked predisposition in coloured people, particularly Africans, to keloid, as well as to other morbid growths of scar-tissue. Instances observed by Dr. Goodhart and Mr. Clutton prove that keloid tumour may grow on different regions of the same patient, and in scars of varying form and origin, either simultaneously or in successive crops. It is probable that there may be a family tendency to keloid. It occurs most frequently in adults, but is not rare in young subjects. In one of a series of cases collected by a committee of the Clinical Society in 1879, the disease had been first observed at the age of six months, and in two other cases at the age of twelve months. According to Kaposi it occurs as frequently in males as in females.

Until recent years keloid was regarded as a permanent disease. The almost general opinion of those who had had much experience of this growth was, that after having slowly and steadily increased up to a certain point, it ceased to undergo any further change, and remained stationary during the rest of the patient's life. Cases have been recorded in which keloid had existed for ten, thirty-six, and forty years. Of late, however, an opinion has gained ground in this country that, as a general rule, keloid growths have a tendency to undergo spontaneous involution, and to disappear.

Excision of keloid is almost always followed by speedy relapse and the formation of a larger growth. Cauterisation, blistering, and the local application of iodine afford very slight prospect of success. Any neuralgic pain that may be associated with the disease is best treated by subcutaneous injection of morphia.

FIBROMA.—Very closely allied to keloid growths are the fibrous and myxo-fibromatous tumours of the external ear, which have been often observed, especially in coloured people, on lobules that have been punctured for the passage of ear-rings. These, though larger and of more rapid growth, present very much the same appearance and structure as keloid, and, as has been shown by Dr. Turnbull of Philadelphia, have a tendency to recur after removal.

MALIGNANT GROWTHS.—Cicatrices, like other forms of imperfectly-developed tissue, occasionally become the seat of malignant or semi-malignant growths. Some few cases have been recorded of medullary and melanotic sarcoma of small scars. The most frequent form, however, of cicatricial malignant tumour is the so-called 'warty growth of scar,' first described by the late Mr. Cæsar Hawkins in 1855. The usual seat of this growth, which in most instances is a papillary epithelioma, is a very old scar formed after a burn or flogging, or the scar of a chronic ulcer. It has been observed on the back, scalp, and heel, but most frequently either in a tense cicatricial band, extending from the arm across the axilla, or on a scar over the shin. Several instances have been observed of a less malignant form of warty growth, the precise structure and nature of which seems to be still undetermined, but which, in the opinion of Follin, is an ulcerating form of keloid.

W. JOHNSON SMITH.

CILIARY BODY, Diseases of the.—

The ciliary body consists of the ciliary muscle, the ciliary processes, and the part of the choroid anterior to the ora serrata. In contact externally with the sclerotic, it forms a zone of about 6 mm. in breadth, measured in a meridional direction from the sclero-corneal margin. This part is called the ciliary region. On the inner surface of the ciliary body is the pigmented uveal layer, which becomes anteriorly the ciliary processes, and is continuous posteriorly with the pigment layer of the retina. The iris, the ciliary body, and the choroid are intimately connected by nervous and vascular supplies; they form, in fact, one continuous layer—the tunica vasculosa, or uveal tract. On account of this close anatomical relation, disease of any one of these structures has a great tendency to spread to the others.

Inflammation of the Ciliary Body (*Cyclitis*) is recognised by the following characters:—There is a zone of congestion surrounding the cornea, due to dilatation of the anterior ciliary vessels, underlying the conjunctiva (ciliary congestion). There is slight photophobia, lacrymation, and ciliary neuralgia. There is also tenderness, often confined to one spot, on pressing the finger over the ciliary region: this marked pain on pressure being a distinguishing feature of cyclitis. The disease has a tendency to recur, to attack one part of the ciliary body more than another, and to produce secondary changes in neighbouring structures.

There are certain cases which indicate, both in their clinical and pathological features, that the inflammatory changes commence in the ciliary body; these will be described first. Cyclitis may also be secondary to iritis, but it is often impossible to say, especially in the later stages, where the primary seat of the disease was situated.

Serous Cyclitis begins with pain and tenderness over the ciliary body, and with ciliary congestion: the pupil may be dilated, but the iris is otherwise little affected; keratitis punctata soon appears; opacities form in the anterior part of the vitreous, producing some diminution of vision. After several attacks of this character, adhesions form between the iris and the lens-capsule, but only at the pupillary margin, followed, in severe cases, by complete exclusion of the pupil, a bulging forward of the iris, and secondary glaucoma. Glaucoma may, however, appear quite early in the disease, before the iris is much affected. In some instances the disease runs a mild course, the iris being wholly unaffected.

Treatment consists in giving the eyes complete rest and in keeping the pupil dilated with atropine. An extensive iridectomy may be performed if the disease persists for long, and is especially demanded when there is any increased tension, with or without exclusion of the pupil.

Cyclo-iritis (*irido-choroiditis*).—In this, as in other forms of cyclitis, the inflammatory changes vary in intensity. They are plastic in character, and are seldom limited to the iris and ciliary body.

A distinct group of cases (*anterior choroido-sclerotitis* which ends in anterior or ciliary staphyloma) take the following course:—At one or two circumscribed areas of the ciliary region there occur repeated attacks of sub-conjunctival congestion, accompanied by pain and tenderness. The area of congestion is sharply limited. The attacks last for several weeks, and are followed by intervals of complete freedom from inflammation. Eventually a slight bulging of the sclerotic at one spot is noticed, and, with each exacerbation, slowly increases. Here the sclerotic becomes thin and of a dusky colour, the choroid and ciliary body showing through it. The neighbouring part of the cornea becomes opaque, and posterior synechiæ are formed. In the later stages the whole of the anterior part of the sclerotic becomes one large staphyloma, the cornea is stretched and enlarged, the iris and ciliary body atrophied. The disease is essentially of a chronic nature, and is often completely arrested for long periods.

This form of cyclitis is very intractable under treatment. The application of the artificial leech and blistering to the temple, combined with the use of atropine, in some cases cuts short the attacks. Other cases are improved by a course of mercury. An iridectomy is sometimes of great value, and may completely arrest the disease.

Cyclo-iritis, in some of its most destructive forms, is more acute, and may commence in the iris or ciliary body, or in both together. A plastic exudation from these two structures gradually envelopes the lens, producing occlusion of the pupil, with total posterior synechia. The lens becomes cataractous, and a cyclitic membrane forms behind it. Early in the disease there is great deterioration of sight, with secondary glaucoma, and a shallow anterior chamber. Later, with shrinking of the vitreous, the eyeball becomes soft.

The exciting cause is sometimes syphilis, either hereditary or acquired. In hereditary syphilis the cyclitis occurs with interstitial keratitis; in acquired syphilis, during the secondary stage. It is in some instances a complication of rheumatic iritis, in many its causation is obscure.

Constitutional treatment, especially in the syphilitic cases, is of the utmost importance. Ciliary tenderness and neuralgia may be relieved by hot fomentations and counter-irritants; local treatment, however, is unsatisfactory. It is impossible to perform an iridectomy with any success, as the iris is very friable, and is firmly bound down to the lens-capsule.

Sympathetic Irido-cyclitis almost invariably begins with serous iritis, soon developing into the most severe form of plastic irido-cyclitis. Some cases never proceed beyond the stage of serous irido-cyclitis, and run a mild course. *See* SYMPATHETIC OPHTHALMITIS.

The ciliary body is sometimes the seat of a *syphilitic gumma*. If the gumma breaks down, a perforation of the ciliary region, with destructive inflammation of the eyeball, may ensue.

A *tubercular growth* in this situation produces great inflammatory swelling of the ciliary body, and is usually accompanied by similar deposits in other parts of the eye.

Injuries of the Ciliary Body.—Blows on the eye sometimes induce paralysis of the ciliary muscle, with dilatation of the pupil and loss of accommodation. Recovery usually occurs in a few days. Hæmorrhage into the anterior chamber or vitreous may also be due to a blow, from rupture of one of the bloodvessels of the ciliary processes. Punctured wounds of the ciliary region are especially dangerous, because traumatic cyclitis may result, and also because an injury of this part of the eye is the chief exciting cause of sympathetic ophthalmitis.

Traumatic Cyclitis is, in the great majority of cases, purulent in character, and is recognised by considerable swelling of the lids, with pain, great tenderness, and congestion of the ciliary region. The aqueous becomes muddy, and pus covers the ciliary processes and the posterior surfaces of the lens, being seen as a yellowish mass through the pupil. This purulent cyclitis is accompanied by diminished tension of the eyeball.

Certain *functional* disturbances of the ciliary muscle are to be noted.

Paralysis of the ciliary muscle alone (cycloplegia) often follows diphtheria, and usually in hypermetropic eyes. Combined with dilatation of the pupil it occurs in complete paralysis of the third nerve; finally, all the internal muscles of the eye may be paralysed (ophthalmoplegia interna). Paresis of accommodation may be the result of debilitating disease, or of overstraining of the ciliary muscle. Spasm of accommodation is sometimes found in hypermetropia. In hypermetropia the circular fibres are often greatly developed, whilst in myopia they are wanting. This, however, is far from being an invariable condition. *See* Accommodation, Disorders of, and Refraction, Errors of.

Atrophy of the ciliary body results from any prolonged pressure applied to it, and is always well-marked in glaucoma of any standing; it is also found in staphyloma of the ciliary region.

The *tumours* of the ciliary body are leuco- and melano-sarcoma. *See* Orbit, Tumours of the.

Coloboma of the ciliary body is a congenital cleft of the lower part, accompanying coloboma of the iris and choroid.

W. J. Milles.

CIRCUMCISION. — The operation of circumcision, or removal of a portion of the prepuce, may be required in the following cases:—

1. To remedy the constitutional and local irritation produced in infancy by an abnormally long prepuce.
2. To prevent the recurrence of balanitis (*see* Balanitis) in lads, produced by the retention of the secretions beneath a long and tight prepuce.
3. To relieve a phimosis produced by balano-posthitis, or by the suspected presence of a phagedænic sore beneath the prepuce.
4. To remove the irritation and difficulty in micturition sometimes present in old men as the result of a long prepuce with contracted orifice.

The usual method of performing the operation in children is as follows:—A tape should first be tied tightly round the root of the penis (a most efficient and simple plan), or Clover's circumcision-tourniquet may be applied, to prevent all hæmorrhage during the operation. The exact length of skin to be removed must then be calculated, either by marking, with an indelible pencil, the skin as it remains *in situ*, at a line corresponding to the corona glandis; or by applying a pair of long polypus-forceps to the same point, and closing them firmly on the skin, as soon as the glans penis has slipped back from between the blades. The forceps should be applied at the point selected obliquely from above downwards and forwards. The portion of skin beyond the forceps is then cut off with a single sweep of a long bistoury, or, better still, with a pair of curved scissors. On removing the forceps it will be found that, whilst the skin has retracted considerably, the mucous membrane still embraces the glans. This must be slit up with scissors well back to the corona, and the angles of the flaps be rounded off. The mucous membrane should then be turned back, and its edge adjusted to that of the skin. Before doing so it is well to secure the mouths of any vessels that can be seen with fine catgut ligature, but in infants this is seldom needful. The edges of the mucous membrane and skin having been neatly adjusted should be kept *in situ* by a long strip of dry lint six or eight inches long and half an inch wide, applied as follows:—

The glans being well pulled forward by an assistant, the middle of the strip of lint is applied to the under surface of the penis immediately behind the glans. The two ends are then passed over and around the organ in successive turns, until the root is reached, when they will lie crossed on the lower part of the abdomen, and must be secured in that position by a couple of strips of adhesive plaster.

The advantages of this method of dressing are that the orifice of the urethra is left free, the cut edges of the mucous membrane and skin are retained in apposition, and the child is unable to pull off the dressings. The tape at the root of the penis should not be removed until this dressing has been applied. It will be observed that no mention of sutures has been made. The fact is that in infants and young lads they are quite unnecessary. If they are used they should be of the finest catgut, and should be placed as near as possible to the edges of the skin and mucous membrane. Such sutures require no removal. The old method of bringing the parts together with a number of silk or wire sutures frequently entailed the second administration of an anæsthetic during their removal. A not uncommon difficulty met with during this operation is the adhesion of the prepuce to the glans penis, especially in the neighbourhood of the corona. Generally these adhesions are easily overcome, but they are occasionally somewhat tough, and require to be broken down with a probe or director. At any rate they should be thoroughly divided, and the prepuce peeled back, so that the furrow behind the corona glandis is distinctly defined.

The after-treatment is of the simplest. The patient must remain in bed for a few days, and the bed-clothes should be kept off the parts by a cradle. On the fourth or fifth day it will be necessary to remove the dressing, and this is most easily accomplished by placing the patient in a warm bath and letting the parts soak for some time. On the removal of the lint it will be generally found that the wound has for the most part healed by first intention. That portion which has not done so will soon fill up by granulation, with little or no distress to the patient. During this process the parts should be protected by a strip of lint spread with vaseline or zinc ointment. A certain amount of œdema, especially in the neighbourhood of the frænum, remains for some weeks after the operation. Although this operation is one seldom attended by danger to life, yet there are cases on record of death from erysipelas and from hæmorrhage after its performance.

In adult cases where the prepuce is not elongated, but the orifice is contracted, the slitting operation will suffice. This may be performed by passing a director underneath the prepuce, and slitting it up with a curved, sharp-pointed bistoury; or a pair of strong, sharp scissors may be used. In either case the incision should be made on the dorsum, and care should be taken to slit the mucous membrane well back to the corona. If the prepuce is elongated a portion should be removed with scissors, the parts being put on the stretch by an assistant taking the two cut angles with a couple of fine spring forceps. These angles should then be rounded off. All vessels must be tied with fine catgut, and the edges of the skin and mucous membrane united by several sutures of the same material.

The wound should then be dressed with a strip of lint soaked in carbolic oil (1–20). The sutures, if any of them require removal, may be taken out on the third or fourth day. Paul Swain.

CIRSOID ANEURISM.—*Definition.* A tortuous and dilated condition of the medium-sized and smaller arteries of a part, extending to the smallest branches, where it terminates in a central pulsating tumour. The vessels especially predisposed to the disease are the branches of the external carotid artery distributed to the scalp; but the arteries of the extremities, scrotum, and trunk are not infrequently the subject of attack. The so-called 'aneurism by anastomosis' of the orbit rarely belongs to the same category.

Etiology.—The conditions which predispose to, or excite, the disease are ill-understood. The tumour generally makes its appearance in early childhood, but may be congenital in origin, or may not appear until adult life. As a rule no cause can be demonstrated, but the morbid changes occasionally extend from a pre-existent nævus, or a more or less satisfactory history of local injury may be forthcoming.

Symptoms.—In a typical case cirsoid aneurism appears as a pulsating tumour fed by a number of dilated tortuous arteries. The tumour is usually moderately prominent, ill-defined at its periphery, somewhat lobulated on the surface, soft in consistence, reducible by direct pressure, and collapsing to some extent during compression of the main vessel. The superjacent skin may be thickened and of normal aspect, or atrophied and more or less transparent. The surrounding tributaries are contorted and irregularly dilated, gradually assuming their proper form and dimensions as they approach the main trunk. A thrill and *bruit de souffle* may be detected over the centre of the growth and for some distance along the course of the afferent vessels.

The whole of the tissues in contact with the diseased vessels undergo atrophic changes, and the subjacent bones may be deeply grooved or even perforated. The temperature of the parts does not usually differ perceptibly from the normal register, but an elevation of between 1° and 2° Fah. has been observed in one case. The affection is sometimes associated with a local neuralgia, but, as a rule, it is painless. The course is variable. In some instances the disease advances progressively from the first, while in others it may remain stationary for long periods, but usually tends to increase rapidly about puberty, or, in women, during pregnancy. In the latter stages hæmorrhages may become frequent and dangerous.

Pathological Anatomy.—The central pulsating tumour has been found to consist of a closely aggregated mass of dilated arterioles transformed into a kind of cavernous tissue by partial absorption of the contiguous walls of the component vessels. The intimate changes in the afferent arteries vary with the period of the disease. In the early stage the walls are said to be thickened, but after a time atrophic lesions supervene, and the tunics become thinned and irregularly dilated into a multitude of pouches. Traces of fatty degeneration have been discovered by some observers in the muscular coat (Labbé, Heine). The veins seldom display any marked changes, notwithstanding the vastly augmented capacity of the arteries.

The true nature of the morbid process is not fully elucidated by the visible alterations of structure. It is still uncertain whether the disease is to be regarded as an active ataxy with hyperplasia, according to which view it may be classed as a vascular neoplasm (Virchow); or whether the first link in the chain is a diminished resistance of the arterial wall, induced either by subacute inflammation (Billroth), or fatty degeneration (Robin, Labbé) of its tissues. It is possible that neither of these views need be rejected, but that some cases may be allied to nævus, in which they are occasionally found to originate; while in other instances a subacute arteritis, with implication of the nervi and vasa vasorum, may be determined by local injury, and of this condition fatty degeneration may be a later stage. Polaillon (*Bull. Soc. de Chir.* 1884) assumes that the essential feature of the disease is an abnormally free communication between the arteries and veins, and he believes the arterial changes to be secondary to this. The theory, however, does not touch the primary cause of the lesion, nor does it explain how such a condition, which would imply a lessened resistance to the flow of blood into the veins, operates in producing dilatation and flexuosity of the afferent vessels.

The *rôle* of local injury in the primary causation appears more important than has been hitherto believed, particularly when the early period of its development in most cases, and its very frequent localisation to the scalp, are borne in mind; the cranium not only being a part especially liable to damage in the course of parturition, and by falls during the first few years of life, but one in which the counterpressure afforded by the bone would render the effects of contusion upon the vessels of the scalp more serious and lasting than in other localities.

Treatment.—There are few non-malignant affections in surgery which have proved more rebellious to treatment than cirsoid aneurism; but it is difficult to avoid the belief that the overwhelming list of failures is, in part at least, attributable to an imperfect conception of the nature of the disease, and to the consequent adoption of wholly inadequate measures for its removal. The problem appears to have been regarded as capable of solution by the same processes of reasoning that have been so profitably applied in the treatment of ordinary aneurism; but there are special features in the cirsoid tumour which so far remove it from surgical aneurisms that the means likely to afford every prospect of success in the latter case must almost assuredly fail in the first. In place of a diverticulum from the vascular wall, out of the direct line of the circulation, and offering conditions eminently favourable to the deposit of fibrinous particles from the blood and to coagulation of the fluid *en masse*, when the hurry of the current can be sufficiently moderated, we have to deal with a multitude of dilated vessels which, though tortuous and sacculated, retain a smooth lining throughout, and offer nothing to interrupt or retard the stream which courses rapidly through them to escape by the veins. Their calibre is always adaptable to the quantity of the circulating fluid, and hence there is no tendency to stagnation of blood, however much the flow becomes diminished in amount. Even the smallest rivulet would be sufficient to maintain the patency and vitality of the diseased vessels until the temporarily enfeebled circulation is restored to its full vigour by collateral supply.

In the treatment of cirsoid aneurism the efforts of the operator have been directed, in the greater number of cases, towards the arrest of the circulation through the focus of disease, either by ligature or acupressure of the individual afferent vessels, or one or more of the larger arteries. It is obvious, however, that in the case of a cirsoid tumour of the scalp it is impossible to secure every one of the tributary branches that converge towards the affected centre. To tie the external carotid leaves open not only all the mesial anastomoses, but many channels of communication with branches of the internal carotid, subclavian, and vertebral, any one of which would suffice to prevent any permanently beneficial result from the operation. Ligature of the common carotid removes only one of the sources of failure; ligature of both carotids brings us a step further, at a risk greatly in excess of the advantage gained; but it is only by tying every great vessel in the neck that the circulation in the tumour could be brought to a standstill. So far is the plan of treatment irrational that the sole cause for astonishment at the published results (which are not likely to be more unfavourable than the results withheld) is that, amid the host of failures and disasters, two or three successes have found a place. It is probable, however, that the cures in question were due to secondary inflammatory processes rather than to the immediate effects of the ligature.

The various methods of treatment may be classified as follows:—(a) Means intended to cut off the circulation through the tumour: such as acupressure of the aneurism and ligature or compression of the afferent vessels or large trunks. (β) Those which aim to induce coagulation of the blood in the dilated vessels: as galvano-puncture and injections of perchloride of iron. (γ) Those by which the whole of the affected tissues are destroyed: as caustics; and, lastly (δ), those undertaken for the entire ablation of the diseased part.

1. *Direct compression* of the tumour has not only been found useless, but is by no means free from danger.

2. *Ligature or acupressure* of the individual afferent arteries has been frequently practised, but with most unsatisfactory results. Out of 13 cases of cirsoid aneurism of the head, collected by Lefort, 11 are noted as failures with 2 deaths, and only 1 appears to have been completely successful (*Dict. des Sciences Méd.*).

Ligature of the larger trunks in similar cases has met with no better reward. Ligature of the external carotid has never succeeded. Of 24 cases of ligature of the common carotid, no less than 23 failures, including 10 deaths, appear against a single success: in two of the instances the operation was undertaken on account of secondary hæmorrhage following a useless ligature of the external carotid. In 9 cases of ligature of both common carotids, two cures are recorded, and the 7 failures included one death. The double operation in the well-known case of Mussey (*London Medical Gazette*, vol. viii.) had so little effect upon the circulation in the tumour, that when the latter was excised a few weeks afterwards the patient lost four pints of blood, and it was necessary to secure forty vessels. The analysis of 26 cases of cirsoid aneurism of the hand collected by Polaillon proves that here also operations upon the afferent vessels give only negative or uncertain results.

The statistics of ligature are so unfavourable as to be almost prohibitive of the operation as a means of cure, but as an adjunct to excision and some other measures it requires further consideration.

3. *Ligature of the tumour en masse*, when practicable, is a more scientific procedure, and has been carried out with success by Foubert and Bryant. Mr. Bryant records two cases, in one of which, however, the disease recurred four years afterwards, and was finally removed by excision. Lefort recommends that the afferent vessels should be secured, as a preliminary step.

4. *Destruction by caustics.*—This method of treatment is theoretically open to some objections, but in one case reported by Bonnet, in 1858, a cure followed the application of chloride of zinc paste over the afferent vessels and afterwards over the whole tumour.

5. *Coagulation of the blood in the diseased vessels.*—Electro-puncture has been successful in one case, and carefully applied in association with circular compression of the afferent vessels would involve but little risk if the needles be connected with the positive pole. Injection of perchloride of iron has been employed more frequently and with variable success. Out of 10 cases collected by Le Fort, 8 terminated in cure, but of the 2 failures 1 proved fatal from septicæmia; while Zielewitz records 6 deaths in 14 cases. It can only be performed safely in conjunction with circum-

ferential compression (continued for half an hour after the injection) or ligature of the afferent vessels. A solution of the strength of 5 per cent. to 10 per cent. would be suitable for the purpose.

6. *Removal by excision.*—This apparently formidable procedure is not only the most certain mode of cure, but, if carried out with due precautions, is comparatively free from danger. The ablation of a cirsoid aneurism of any size would, however, lead to enormous hæmorrhage, unless preceded by some measures for limiting the access of blood to the part. Hitherto the excision has rarely been performed except as a last resource after the afferent vessels or larger trunks have been tied without benefit, and under these circumstances, owing to the speedy establishment of collateral circulation, the advantages of the ligature are lessened in proportion to the time allowed to elapse between its application and the removal of the tumour. Thus, in Mussey's case, although both common carotids had been tied, the hæmorrhage was terrific when excision was performed a few weeks later. To secure the best results it would appear advisable that the ablation should be *immediately* preceded by the ligature or acupressure of every accessible tributary; the smaller unsealed arteries could then be seized as soon as exposed, and the operation would probably be completed without serious loss of blood, while the special risks appertaining to the ligature of the larger trunks, and particularly of the common carotid, would be evaded. In cirsoid aneurism of the hand, amputation of the member may be performed should coagulants and other measures fail.

It has been observed that the dilated and tortuous arteries tend to return to their normal condition after the cure or removal of the pulsating tumour. This fact indicates the latter as the starting-point of the disease, but still leaves its intimate pathology open to discussion.

In conclusion may be noticed two measures which have been tried with success, each in one instance—the use of setons after ligature of the supplying vessels (Southam), and circular section of the tissues around the tumour, also after preliminary ligature of the afferent arteries, followed by compression in the line of the incision (Verneuil). William Anderson.

CLAVICLE, Dislocations of the.—The clavicle may be dislocated at its acromial or sternal extremities. The acromial dislocations, which are the most common, will be described as dislocations of the scapula. In spite of the simple arthrodial nature of the clavicular joints, and of the exposed situation of the bone, injuries from falls upon the shoulder commonly result in fractures of the clavicle or in dislocations of the shoulder-joint, and but very rarely in displacement of either extremity of the clavicle from its articulation, as dislocation is prevented by the strong supplementary ligaments of these joints.

The *sternal end* of the clavicle may be dislocated in three directions—*forwards*, *backwards*, and *upwards*. These might be conveniently named the ante-sternal, post-sternal, and supra-sternal dislocations of the clavicle.

The *forward dislocation* (ante-sternal), is usually caused by violence applied to the anterior part of the shoulder, forcing the outer end of the clavicle backwards. In children it may be caused by lifting them by the arm, and Fergusson mentions a case which happened during birth. It may be *partial*, in which case the end of the clavicle projects somewhat beyond its normal level, and may be readily pushed back; or it may be *complete*. In the latter case the displaced bone passes forwards, inwards, and somewhat downwards upon the sternum, where it forms a very distinct projection. It could only be mistaken for a fracture close to the articulation or a separation of the epiphysis. By extending the shoulders, which may be effected by the knee pressed on the spine, aided by pressure on the dislocated bone, the deformity is readily made to disappear, but the difficulty of retaining the bone in position after reduction is very great. The treatment usually adopted is to put the arm up in precisely the same way as for fracture of the clavicle, with the addition of a pad secured by strapping over the sternal end. In the case of a lady it might be worth while to insist on the recumbent position being maintained till firm union had been secured. In any case the arm must be retained in bandages for six weeks or two months. Even then a false joint is a common result; but such a termination gives rise to little impairment of the usefulness of the limb. Hamilton relates a case in which he found it impossible from the first to reduce the dislocation, and the bone was left in the position in which it was found. Putégnat has recorded the case of a girl of seventeen who could voluntarily produce forward dislocation of both clavicles as an amusement. The double luxation had followed a severe fall upon the hands.

Dislocation backwards (post-sternal) may be produced by a fall on the back of the shoulder, forcing the outer part of the clavicle forwards, or by a direct blow upon the inner end of the bone, or by lateral compression of the shoulders. It has also been brought about gradually by extreme curvature of the spine. In order of frequency it stands next to dislocation forwards. The bone is not driven simply backwards, but becomes lodged between the upper edge of the sternum and the trachea, causing dyspnœa, difficulty in swallowing, and pain in the neck—symptoms which the patient endeavours to relieve by bending his head forward, and which are increased by throwing the head back. In a case related by Pellieux, however, these severe symptoms were not present, owing probably to the end of the clavicle not having been caught behind the edge of the sternum. In the position of the prominent end of the clavicle a depression is present, into which the finger may be dipped. The acromion is somewhat nearer the median line, and the clavicle is directed from this point inwards and backwards. In a case dissected by Erichsen, the rhomboid ligament remained unruptured, and had carried away with the clavicle the cartilage of the first rib.

The treatment of backward dislocation has been more successful than when the bone is displaced forwards. The deformity is easily reduced by placing the knee on the spine and drawing the shoulders back. To retain the bone in position, the shoulders should be fixed to a broad splint placed transversely behind the scapulæ. The splint should be thickly padded, or a small pillow may be introduced between it and the spine. The shoulders should be retained in this position for two or three weeks, after which time the splint may be removed, but the movements of the shoulder on the affected side should be restrained for two or three weeks longer.

Dislocation upwards (supra-sternal) is produced by a force acting from above on the point of the shoulder, by which the acromial extremity of the clavicle is driven downwards and inwards. The sternal end is in this way torn from its attachments, and rises between the sternal head of the sterno-mastoid and the sterno-hyoid muscles; at the same time it passes inwards so as to lie above the sternal notch, and may reach, or even pass under, the edge of the sterno-mastoid of the opposite side, as in a case observed by Malgaigne. Bryant describes the case of a young woman seen by him two years after she had been crushed in a crowd, where there was displacement of the inner extremities of both clavicles, which, by pressure upon the shoulders, could be made to touch. R. W. Smith obtained a dissection in one case, and found all the ligaments, including the rhomboid, torn, and the inter-articular fibro-cartilage separated from its sternal attachment.

The symptoms are depression of the shoulder, which approaches nearer the median line, and visible elevation of the sternal extremity of the clavicle. The sternal origin of the sterno-mastoid muscle is pushed forward by the bone, and a depression can be felt at the site of the damaged articulation. The displaced bone encroaches upon, and partially or completely obliterates, the episternal depression. The dislocation is easily reduced by raising the shoulder, and at the same time drawing it back.

For this dislocation the writer is inclined to think Velpeau's suggestion is the best. This surgeon carried the elbow forward so that the hand rested on the sound shoulder, then supported the elbow, and bound the arm to the side by means of a dextrine bandage, which was kept on for fifty days. When the elbow is carried forward, the humerus may be used to push the acromion upwards and backwards, and the writer has found this position of great service in treating dislocation at the acromial extremity of the clavicle.

Simultaneous Dislocation of both ends of the Clavicle.—There are four recorded cases in which at the same time that the sternal extremity of the clavicle was dislocated forwards, the outer end was displaced above the acromion. To treat such a case it is necessary that the shoulders should be drawn well back, and retained in that position whilst a compress is placed over the bone to steady it.

R. Clement Lucas.

CLAVICLE, Fracture of the.—This bone is commonly fractured at all periods up to advanced life; but nearly half the cases are those of children under six. Several instances of intra-uterine fracture of this bone by external violence are on record. The fracture may be transverse, or very oblique; incomplete (greenstick), multiple, or comminuted; it is very rarely compound. The break is most commonly situated at the outer part of the middle third, where the bone is small, and where the two curves meet, but any part may give way. Owing to the absence of displacement and of crepitus, incomplete fracture is apt to be overlooked. When displacement occurs, the sternal fragment is more or less tilted up by the sterno-mastoid, and the acromial end is carried downwards and inwards by the weight of the arm and the action of the surrounding muscles. The sternal end thus overrides the acromial. This position is, very occasionally, reversed. The sternal end, when short, has been seen nearly erect. Occasionally both clavicles are broken.

Symptoms.—The shoulder drops inwards, downwards, and forwards, so as to contrast strongly with the opposite side, with which it should always be carefully compared. The patient leans over to the injured side, and often supports the elbow with the other hand. Deformity of the bone can be felt, and often seen. Swelling over the fracture is often well-marked. Crepitus is felt, if not before, by raising and drawing back the shoulder so that the fragments are brought into contact; there is acute pain at the seat of fracture, especially on movement; rarely ecchymosis. In children displacement is usually slight, and the only signs are pain, swelling, and a momentary 'click' on movement. At the sternal end fracture produces slight displacement; at the acromial end considerable; in fracture between the conoid and trapezoid ligaments displacement is very slight, or entirely absent. The vessels and brachial plexus generally escape injury; but cases of rupture of the artery, and others of the subclavian or internal jugular vein, and many of paralysis of the arm from injury to the brachial plexus, have been recorded. Paralysis may be caused by ill-applied pads and compresses. Failure of union is very rare. The functions of the arm are regained, even though deformity is considerable.

Treatment.—It is often difficult or impossible by any apparatus to keep the fragments exactly adjusted. Deformity and bony swelling are most securely prevented by keeping the patient in the horizontal posture, with the shoulders resting on a flat mattress, for a fortnight or three weeks, but few care to submit to this treatment. The old figure-of-8 bandage has been generally discarded. Many complicated appliances have been proposed as substitutes, but simple means are the most efficient. A wedge-shaped pad may be placed base upwards in the axilla, the elbow drawn a little backward on the chest, and it and the forearm be raised and supported by a sling passed over the opposite shoulder. The arm should then be securely, but not tightly, bandaged to the side. The bandages should be sewn together here and there, or brushed over with starch, to fix them. Ellis's apparatus, consisting of a crutch-pad, sling, and strap for the arm, conveniently carries out this plan; or Sayre's method, which seems at present to be generally popular, may be used:—'Two strips of plaster, spread on moleskin or strong calico, are cut, each three and a half inches wide for an adult: one long enough to encircle first the arm and then the body completely; the other to reach from the sound shoulder over the elbow of the broken limb, and across the back obliquely to the point of starting. The first piece is looped around the arm just below the axillary margin, loosely enough to avoid constriction, and the loop is strongly sewn. The arm is then drawn downwards and backwards, so that the pectoralis major is put on the stretch, and the long end of the strapping is then carried completely round the body, and is stretched to itself on the back. The second strip is then applied, commencing on the front of the shoulder of the sound side, is thence carried over the top of the shoulder, diagonally across the back, under the elbow, diagonally across the front of the chest to the point of starting, where its ends are securely sewn together. A longitudinal slit is made in the plaster to receive the point of the elbow. Before laying the plaster across the elbow, an assistant must press the elbow well forwards and inwards, and it must be held firmly in this position until the dressing is completed. It will now be seen that the arm has been converted into a lever, whose fulcrum is the loop of plaster at the lower margin of the axilla, and upon this it is believed that, in a great measure, the efficiency of the apparatus depends.' Hamilton does not favour this method, nor can the present writer. He agrees with Hamilton that, when all has been said, some simple appliance, consisting of a sling, an axillary pad, and a bandage to keep the arm to the side, is still the best that can be used. Union is generally complete in children in about three weeks; in adults in from a month to five weeks. Should stiffness of the shoulder-joint remain, the limb should be gently moved through its full range when the patient is under the influence of an anæsthetic. For this purpose nitrous oxide gas is generally quite sufficient. In comminuted fractures, should there be evidence that the vessels are pressed upon, the patient should be confined to the horizontal position, with the arm slightly drawn away from the side. HOWARD MARSH.

CLAVUS. *See* CORNS.

CLEFT PALATE, The Mechanical Treatment of.—The successful treatment of a cleft palate by a mechanical appliance is dependent upon a clear recognition of the conditions that are essential in the treatment of all cases of cleft palate, whether the method be surgical or mechanical.

These conditions are:—

(1) The restoration of continuity of surface in the palatine arch.

(2) Separation of the arch of the palate from the floor of the nose.

(3) The possibility of cutting off communication between the mouth and the naso-pharyngeal cavities, at the will of the patient, by contact between the edge of the free border of the palate and the posterior wall of the pharynx, irrespectively of the nature of the means by which the *velum palati* has been restored.

It does not come within the scope of the present article to indicate how far these conditions may or may not be fulfilled by the operation of staphyloraphy. It is only necessary to indicate the nature of the various appliances that have been invented and used for the treatment of congenital fissure, dealing, however, only with those that possess some element of utility combined with novelty.

It is unnecessary to enter into the details by which an impression is obtained of the mouth with its fissured soft palate, soft and hard palate, or even fissured soft and hard palate and alveolar arch. Whether the cleft be limited to the uvula, or pass through to the front of the mouth and be combined with single or double hare-lip, is a matter of but little moment for our purpose. It simply resolves both deformity and treatment into a question of degree, and does not affect the principles involved in treatment.

Starting with the assumption that a perfect model of the mouth has been obtained, three methods of dealing with the case present themselves for consideration.

We will discuss the simplest way first. This consists in adapting a gold, platinum, or thin vulcanite plate to the front part of the mouth, filling up all gaps in the dental arch with artificial teeth, and covering over any portion of the fissure that may exist in the hard palate, and restoring it to symmetry of form and relative smoothness of surface. Such a plate is held in position by bands passing round the natural teeth, and, as a rule, covers the whole of the anterior part of the mouth and passes backwards nearly to the boundary of the normal hard palate. Attached to the posterior margin of the plate by means of studs, screws, stitches, or clamps, we have an artificial *velum palati*, made of elastic rubber, either moulded expressly for the particular case or cut out of a sheet of elastic varying in thickness according to the size of the cleft and the age of the patient; thus, for a child under ten years of age, 2 millimetres thick would be sufficient, whilst for an adult it may be 3 millimetres or even 4 millimetres with advantage. The elastic flap must extend back to such an extent that, by the upward pressure of the tongue, the artificial velum will be brought into absolute contact with the posterior wall of the pharynx.

Here it will be seen that we fulfil most of the conditions that have been laid down as essential to successful treatment by mechanical means. We have simplicity of construction, and an appliance that can be worn with relatively little trouble; but against this we have an elastic velum that, from its nature, must of course be perishable and apt to break down in texture, and become offensive in odour if not kept very clean and frequently renewed. It must be further observed that the whole appliance is very much of the nature of a valve covering an opening, and is not in any sense a plug or obturator in relation to the lateral boundaries or walls of the cleft. It will also be seen that the elastic velum, attached at one margin only, does not in any way represent the tense, resonant surface of the normal soft palate. The cases treated by this method have, however, given exceedingly satisfactory results in many instances, and the name of the late Mr. Edwin Sercombe, who did much to make it popular, should always be remembered in connection with this form of artificial palate.

Following on the lines of Stearn (an English surgeon who wrote about 1845), Dr. Kingsley, of New York, introduced, in 1864, a very perfectly constructed form of elastic velum which at once fulfilled nearly all the conditions that the writer has already stated to be essential. The Kingsley velum was, roughly speaking, of the nature of a stud, and, if we think of the fissure as like a button-hole torn open at one end, it will be easier to understand how the stud passed through the open end of the button-hole and, by being kept forward at the perfect end of the button-hole, became self-supporting; in other words, there was a flap to reproduce the floor of the nares, a flap to restore the palatine arch, and the two flaps were held together by a stem that was fitted to the margins of the cleft. All this being in one, and made of elastic rubber vulcanised in metal moulds, a very beautiful appliance was produced; and when fixed in the mouth by attachment to a gold plate fitting the lingual aspect of the teeth, the elastic velum moved up and down with the muscular movements of the divided soft palate, and could be brought into contact with the posterior wall of the pharynx. The earlier instruments made by Kingsley have not been described, as they were wrong in certain details and unnecessarily difficult to make, and, from their extreme tenuity, wore out very quickly. The modified Kingsley velum, however, is a most useful invention, and has been applied in a large number of cases by the late Mr. Ramsay and the writer. The only objections to it are its destructibility by the secretions of the mouth and nose, and its want of resonance as compared with other materials. It will be recognised at once that Kingsley's velum is partly of the nature of a valve and partly of the character of an obturator, plugging up the cleft.

The third method of mechanical treatment to be considered is due to the inventive faculty of Dr. Wilhelm Süersen, of Berlin. It consists of an obturator made of hard rubber, the fore part fitting around the teeth and covering the hard palate, and the rest filling up the gap of which the margins of the fissure and the wall of the pharynx are the boundaries. The front portion is of no moment; its use is obvious—namely, to support the part of the instrument that fills up the cleft. The obturator proper, however, is very interesting in form, though commonplace in material and construction. It consists of a pyramid having its base parallel with the posterior wall of the pharynx and its apex towards the anterior point of the cleft. One side of the pyramid is on a plane with the natural palate in so far as it exists, the upper side forming the floor of the nares, and grooved down its centre for the free passage of secretion. The two remaining sides of the pyramid are in contact with the lateral margins of the cleft, but do not fit so closely as to produce any pressure when the palate is in a state of repose; but as, in the process of swallowing and in the utterance of certain sounds, the muscles of the palate are drawn upwards and increased in volume laterally, so pressure is exercised upon the rigid obturator, and perfect occlusion between the mouth and the nose takes place along the margins of the cleft. At the same time, the muscular tissue of the upper and posterior part of the pharynx is thrown into well-marked action, with the effect that the space between the base of the pyramid and the wall of the pharynx is completely blocked up by the increased bulk of the muscles in this position; thus the naso-pharyngeal cavities are separated from the mouth coincidently with the closure of all communication between the nose and the oral cavity.

Such an appliance offers the following advantages over those already described:—It is easily kept clean. It does not undergo any change in texture by use in the mouth. It cannot easily be broken or damaged; and, above all, it produces a far more resonant quality of voice than if an elastic velum be used, and this resonance is still further increased if the lower surface of the palate, with the front portion, be made of gold.

The most perfect appliance will produce, however, the most disappointing results unless the patient be intelligent and painstaking. It must always be borne in mind that the restoration of an organ is not the restoration of a function, but simply a means to that end. Hence, where the work of the dental surgeon leaves off, the skill of the teacher of elocution should begin.

Oakley Coles.

CLEFT PALATE, The Surgical Treatment of.—The palate may be congenitally cleft in very varying degrees, from a bifid uvula, which represents the simplest form and the slightest extent of the deformity, to a complete separation of all the structures forming the hard and soft palate.

The soft palate may be cleft to uncertain degrees, but it is rarely completely divided without there being at the same time some want of union of the palate-bones.

The hard palate, consisting as it does of six symmetrical bones, usually presents one of three degrees of non-union in the middle line, viz. either the palatine portions of the palate-bones are alone separated, or with them the palate-plates of the superior maxillary bones are cleft, or, in addition, the intermaxillary bones and alveolar arch are divided.

The failure of union is usually rather to the left side of the middle line; and, in clefts involving the hard palate, the septum nasi is generally united at its lower border with the right maxillary bone; but in some of the worst cases the bony septum of the nose hangs free, at its lower edge, being altogether unconnected with the bony palate. Clefts of the hard palate alone are scarcely ever met with; occasionally the failure in the process of union shows itself in the existence of congenital holes in the middle line of the palate, but these are very rare as a congenital defect, though they may be seen as the result of disease.

Symptoms.—The defect, if combined with hare-lip, is usually sufficiently obvious. In the slighter degrees of cleft-palate there may be no such interference with suction and deglutition as to attract attention; while in some cases the only noticeable symptom is the occasional escape of milk from the nostrils. More frequently the child cannot suck at all; or, if able to suck, it can only swallow a small quantity, the greater part of the milk escaping by the nostrils. Among newly-born infants, in any case of unexplained difficulty in taking food, it is well to examine the condition of the palate.

Treatment.—Since the only inconveniences of cleft-palate in early infancy are connected with suction and deglutition, the only treatment required at this age has for its object to secure a sufficient supply of food. Where a child cannot suck or retain its food, an attempt should be made to give nourishment very slowly, with a small spoon passed far back into the mouth, or, as recommended by Mr. Coles, an ordinary feeding bottle may be used, having a thin leaf-like sheet of india-rubber fixed above the teat, sufficiently large to occlude the cleft in the palate.

In many cases the child can be fed from a bottle with an india-rubber teat big enough to fill the gap in the palate; the teat having a large hole on the under side near its extremity, so that the milk can easily escape. Even in the worst cases children can be fed by using an old-fashioned flat feeding-bottle having a large teat, with a hole in its extremity through which food can be poured into the pharynx at suitable intervals by tilting the bottle.

Age for operative treatment.— The earlier in life the defect is remedied the more satisfactory will be the result as regards the perfection of articulation, and cases have occurred in the writer's experience where, after a successful operation at a very early age, no defect whatever has been noticed when in due time the patient had learned to speak. But the age at which the operation should be performed must vary with the nature and degree of the cleft, and the health and vigour of the patient. Doubtless the deformity can be cured in very early infancy, but regard being had to the difficulty and even danger of the proceeding, and the many possible causes of failure at this period of life, it is prudent to postpone operative treatment.

In the first three or four years of life, clefts of the bony palate generally diminish greatly in width, especially at their anterior extremity, where in the process of growth fissures in the alveolar arch may be observed to close altogether by coalescence of their opposite edges. Thus with the lapse of time the operation becomes less difficult of performance and no longer dangerous.

None but very general rules can be laid down as to the best time for operating, since each case must be judged on its own merits, and every surgeon will be guided chiefly by the results of his own experience. In deciding this question, the difficulty of the operation and the constitutional condition of the patient must be taken into consideration, and in estimating the difficulty of the proceeding, regard must chiefly be had to the width of the cleft in relation to the amount of material available for its closure.

In the case of the soft palate, this may easily be estimated by observing the width and thickness of the sides of the velum; in clefts of the hard palate the pitch of the palatine arch should chiefly be noticed. for the higher the palatine arch the more material will be available for flaps. The union of the septum nasi with one maxillary bone is also a favourable condition, as furnishing on one side at least an abundant flap; the mere length of a cleft adds little or nothing to the difficulty of closure.

In healthy children, clefts involving the velum only, without deficiency of the soft parts, may generally be cured in the third year of life. Fissures which affect the soft palate and more or less of the hard, may, as a rule, be closed before the end of the sixth year, if the cleft be not very wide and there is a sufficiency of material for flaps.

In cases of unusual local difficulty, or where the general health is feeble or there is considerable infirmity of temper, the operation may need to be still longer postponed; but, if the case be curable at all, it is rare that this cannot be accomplished before the patient is twelve years of age. When, from one cause or another, the operation has been long delayed, though a successful union may be more easily obtained, the results as regards articulation will be less satisfactory.

Order of operation.—There is some difference of opinion as to whether the union of the hard and soft palate should be attempted in one operation. The writer believes he has sufficient experience to justify him in recommending that the whole cleft should be closed at one and the same time, unless there are circumstances of peculiar difficulty in the case. When the bringing together of the whole cleft in one operation would necessitate so free a division of the soft parts as to endanger the vitality of the flaps, it is advisable to close first that part of the cleft that can be most easily approximated, whether it be the hard or the soft palate. This, if successful, will secure for the remaining portion a large supply of blood in the subsequent operation.

Instruments.—A cleft-palate case should contain—two sharp-pointed tenotomy knives mounted on long handles, for paring the edges of the cleft; one blunt-ended knife of the same kind, for making lateral incisions to relieve tension; a small rectangular knife (Fergusson's), for tracing a flap, when one has to be brought down from the septum nasi.

Two pairs of long forceps—one mouse-toothed, the other serrated; a fine double hook. A pair of strong sharp-pointed scissors curved to a quarter circle, for dividing the connection of the soft palate with the nasal mucous membrane, at the posterior margin of the hard palate. Two raspatories curved as an aneurism needle; one raspatory very slightly curved. Two needles with eyes at the point mounted on long handles, for horsehair or silk; an instrument for catching these sutures at the eye of the needle.

A tubular needle with reel at the base for passing silver sutures, and a wire twister.

A gag of some kind is essential; it should be strong enough to keep the jaws open, and so arranged as to dilate the orifice of the mouth as much as possible, while it depresses the tongue. As is natural, the writer prefers the gag known by his name, but it may well be that other instruments of a similar kind are quite as useful. Cases are met with where the continued depression of the base of the tongue causes difficulty in breathing; for these the gag invented by Mr. Coleman or Mr. Mason is specially adapted; it leaves the tongue free and occupies but little room in the mouth. If this be used the tongue should be held down by a rectangular spatula.

The needles for passing horsehair or silk should be on long, slender handles; they should be rectangular in their curve, flattened laterally, and having a round eye close behind the point.

The best materials for sutures are well-annealed silver wire and horsehair; the wire for the hard palate, or for any part of the soft palate, anterior to the uvula, where there may be tension, the horsehair for the uvula, and the lower and more flaccid part of the velum. Both the wire and the horsehair should in their size be proportioned to the thickness and consistence of the parts to be brought together, that used for the uvula being thinner than should be employed for the velum itself.

Operation.—The patient having an empty stomach, though being in no want of food, may be conveniently placed in the recumbent position on a narrow table in front of a window, the head, thrown well back, being held on a firm pillow by the assistant who also takes charge of the gag. As a support for the head a small inflatable air-cushion is to be preferred. Two assistants are required besides the administrator of chloroform, one to steady the head and hold the gag, the other to assist in the actual operation. The complete quietude of the patient should be secured by means of a wide strap passed across the thighs and beneath the table; to this strap the hands should be loosely tied.

Operation on the Soft Palate.—The patient being under chloroform the gag should be introduced, the jaws opened, the tongue tucked under the tongue-plate, and the patient's head and gag entrusted to an assistant.

The edges of the cleft may best be pared from below upwards, the point of the uvula being held with the toothed forceps, to render the palate tense. The sponge should be sparingly used, as it tends to produce vomiting, and the flow of saliva increases. Sutures may also be conveniently passed in the same order, and be fastened, if the palate will come together, and cut off, one after another as they are fastened; one suture, the last passed, being always left in the palate, uncut, to be used to draw forward the margins of the cleft, to assist in passing the next suture. The sutures should be passed through both sides of the palate at one transit of the needle, and if the cleft will come together they should be fastened off at once—the horsehair by tying, the wire by twisting.

When there is too much tension to admit of the sutures being tied at once, they should all be passed, and, being loosely twisted, the long ends may be cut off, and longitudinal incisions may be made on either side, parallel to the cleft and just internal to the hamular process, avoiding the immediate neighbourhood of the posterior palatine foramen. It is well to make this incision with a blunt-ended knife, after puncturing the palate with a sharp-pointed knife. Sufficient relaxation being obtained, the remaining sutures should be quickly fastened off by twisting with torsion forceps.

In cases where the cleft involves more or less of the hard palate, when the soft palate has been closed, so far as it can be without undue tension on the sutures, the operation on the hard palate can be at once proceeded with, if there is nothing in the patient's general condition to forbid it.

Operation on the Hard Palate.—If there is sufficient material for closing the palate the mucous edges of the cleft may be pared. If there is any doubt about this, the proceeding must be dispensed with, as involving a waste of flap.

To bring down the muco-periosteum from the bones, a mere puncture should be made down to the bone with a scalpel, midway between the teeth and the margin of the cleft and opposite the middle of the cleft, midway between the anterior angle of the cleft and the posterior margin of the hard palate. Through this puncture the least curved of the raspatories should be thrust between the periosteum and the bone, and be pushed onwards towards the middle line until its point appears in the cleft. At this spot one of the more curved raspatories should be inserted, the instrument first used being withdrawn. The curved raspatory should now be used to separate the muco-periosteum from the bone, and this is best accomplished by to-and-fro movements and by careful traction. The periosteum is easily detached until the posterior margin of the hard palate is reached, where the soft palate is firmly attached by fascia and by its connection with the mucous membrane of the floor of the nose.

Curved scissors should be used to divide this attachment, the palate being drawn forward with a hook to put it on the stretch while the scissors are passed behind it. The scissors may now be used with closed blades, as a raspatory, to draw forward the soft parts at the junction of the hard and soft palate and complete their separation from the bone. When the hard palate is cleft up to the incisor teeth there is often difficulty in completely separating the periosteum at the anterior angle of the fissure. Should this be the case a small rectangular knife can be used to free the soft parts.

The muco-periosteum being completely separated from one side of the palate, the assistant should thrust a sponge into the cleft and press the flap firmly against the bone. This will restrain all hæmorrhage, give an opportunity for cleansing the fauces from blood, and allow of the re-administration of chloroform.

The soft parts being separated from the bone on the opposite side of the cleft in the same manner, the sutures may be passed as in the soft palate, silver wire being used and each suture being twisted up as far as practicable without risk of breaking, and cut short, so as to leave about a sixth of an inch projecting.

Tension should be relieved by prolonging the small incisions made for the introduction of the raspatory, forwards or backwards, as the circumstances of the case may require. The incisions should go quite through the palate, and they are best made with a probe-pointed knife. All slack sutures should now be twisted up with torsion-forceps until the edges of the cleft are in exact apposition.

In bringing together this part of the palate, care must be taken to evert the edges of the cleft with a small double hook in passing and twisting up the sutures ; this secures the apposition of the raw surfaces of the flaps, and it is especially necessary when the edges of the cleft have not been pared.

During the course of the operation there will be frequent interruptions, necessary either for giving chloroform or for freeing the fauces from blood. During these periods a sponge should always be kept pressed firmly into the cleft. The forceps should be very sparingly used to the palate in the operation. Bleeding is better restrained by sponge-pressure than by syringing. Forceps are the best sponge-holders ; with them sponges can be seized or dropped in an instant.

In cases where the material for closing the cleft is scanty, a flap must be brought down from the septum nasi, and this can always be done when the septum, as is usually the case, is united with one of the maxillary bones. This flap should be traced out on the septum with a small rectangular knife, and brought down with a sharply curved raspatory.

After-treatment.—No food should be given until two or three hours after the operation, or until vomiting has ceased; for the first twelve hours, cold milk, or milk and water, will suffice, and after this time the patient can be fed on lightly boiled eggs, soft bread and milk, rice-milk, cream, custard, stewed fruits, arrowroot, beef-tea, pounded meats, porridge with milk, &c. These, or such as these, may form the chief articles of diet for a fortnight. It is desirable, but not always possible, in the case of children and delicate young persons, to keep them in bed for a week. Sutures of wire or horsehair may be left in for three weeks or much longer; they should not be removed until after a fortnight from the time of the operation. The palate, in young children especially, had better not be inspected during the first week.

The writer has never met with dangerous, or even severe, hæmorrhage after the operation; but should such occur, and ordinary means fail to arrest it, pressure on or in the posterior palatine canal of the bleeding side would almost certainly put a stop to the bleeding.

It is well to recognise that the cure of a cleft palate does not cure the defect in articulation; it does, however, allow of the patient being taught, or of his teaching himself, to speak with more or less distinctness. The perfection of the result in this respect depends mostly on the care taken to correct defects in articulation by systematic instruction; much also depends on the irregularity, or otherwise, of the dental arch, and the stiffness or pliability of the new velum. M. Trélat insists on the advisability of systematic teaching preceding the closure of the palate, and with this object he postpones the performance of the operation until a later date than is advised by many surgeons. He fixes seven years as the minimum age at which the cure should be undertaken, considering that at an earlier date the operation is dangerous, compromising, or useless. Thomas Smith.

CLINE'S SIDE SPLINTS are adapted to the shape of the leg and foot. They are usually sold in couples, the inner of which is not provided with a footpiece, possibly with the object of allowing inversion of the foot, when used for Pott's fracture. Splints similar to these, but each having a footpiece, are known as either Cline's, Pott's, or Bell's splints. Bilton Pollard.

CLITORIS. *See* Vulva.

CLONIC SPASM.—A condition of general spasm with distinct remissions. *See* Hydrophobia.

CLOVE-HITCH, a tie which has the advantage of maintaining a firm hold on the limb to which it is applied without becoming tighter, so long as both ends of the bandage or cord are pulled equally. It is used in reducing dislocations, and is most readily made by forming two simple loops in a jack-towel or bandage, and passing the second loop under that first made.

CLUB-FOOT or TALIPES signifies any deformity of the foot caused by an unnatural contraction of muscle, tendon, fascia, or ligament. The varieties of club-foot are: (1) *Talipes equinus*, in which the heel is raised and cannot be brought to the ground, and the patient walks on the toes and the distal ends of the metatarsal bones. (2) *Talipes calcaneus*, the reverse of the last-named variety, in which the heel is depressed and the toes are raised, so that the patient walks on the former. (3) *Talipes varus*, in which the inner edge of the foot is drawn upwards, and the anterior two-thirds of the foot are twisted inwards, the outer edge resting on the ground. (4) *Talipes valgus*, the reverse of talipes varus, in which the outer edge of the foot is drawn upwards, so that the patient rests on the inside of his foot and inner ankle.

These forms are also found in combination, viz.: (1) *Talipes equino-varus.* (2) *Talipes equino-valgus.* (3) *Talipes calcaneo-varus.* (4) *Talipes calcaneo-valgus.*

Talipes may be either congenital, or may come on after birth. The cause of the congenital variety is very obscure. The writer believes it to be due to disordered nervous function acting on the muscles, which draw the foot into its deformed position; and this opinion is confirmed by the occurrence of talipes in cases of spina bifida.

Non-congenital talipes is due to various causes, chief amongst which are: Paralysis, spasmodic contraction of muscles, rupture of tendon or muscle, and the cicatrices following burns and other lesions.

Although space will not allow the pathology of club-foot to be fully considered, it may be mentioned that, in addition to the contracted condition of muscle and fascia, the bones of the tarsus, especially in congenital cases, will be found slightly altered in shape and size, and displaced from their proper positions.

Varieties of Club-foot.—Talipes Equinus (in which the heel is raised and cannot be brought to the ground, and the patient walks on the toes). This form of talipes is hardly ever congenital. On examining a case of simple talipes equinus, the foot will be found to be in a straight line with the leg, neither inverted nor everted, and on attempting to flex the foot on the leg, the tendo Achillis can be felt as a rigid band holding the heel in its raised position. In the majority of these cases nothing else is at fault; but in some, on further examination being made, the arch of the foot is found unduly flexed, and the plantar fascia is to be felt tightly contracted. In some rare cases of an unusually severe nature, the tendon of the posterior tibial or those of the peronei muscles will be noticed preventing the foot being placed in its natural position. In addition to these causes of talipes equinus, in many cases there is considerable stiffness of the ankle-joint, with a contracted state of the ligaments around the joint. This will be found to vary greatly in each case, and in some to be entirely absent.

The *Treatment* of talipes equinus consists in the subcutaneous division of the abnormally contracted tendons and fascia, and, after the punctures made by the tenotome are healed, the gradual extension of the foot by means of a Scarpa's shoe. The amount of force to be used must depend on the resistance caused by the adhesions in and around the ankle-joint. In those cases in which, after division of the contracted tendon, the foot can at once be placed in the natural position, great care must be taken to keep the divided ends of the tendo Achillis in apposition until they have partially united, and to extend with caution, lest the tendon become overstretched and the case be converted into one of talipes calcaneus. It must be observed, moreover, that when the plantar fascia as well as the tendo Achillis is contracted, it must be divided *first*, as the resistance offered by the contracted tendo Achillis offers the necessary resistance which is required in stretching it. After division of the tendo Achillis, the patient should not be allowed to rest on the foot for at least six weeks, lest the tendon become unduly stretched. After the foot has been brought to its natural position by the means indicated, a boot with a steel support will in most cases be required.

If the case be one of paralysis, and the patient has not the power to flex the foot on the leg, a back-stop must be fixed into the joint of the support, so as to allow the foot to be bent up, but to prevent its falling beyond a right angle with the leg; and the patient should wear the apparatus at night to retain the foot in its proper position, as there is danger of a relapse if this be not done. This deformity being usually due to infantile or other paralysis, it is necessary, when the foot has been brought into a good position, to supplement the weak extensor muscles by some form of elastic support, by which the toes may be raised from the ground in walking. This can be effected either by elastic cords passing from a collar below the knee, supported by a light outside steel from the foot; or, better, a double-curved steel spring can be attached to the outside steel, so as to keep the foot flexed when the weight of the body is not thrown on the toes.

Talipes Calcaneus (in which the heel is depressed and the toes are raised, so that the patient walks on the posterior end of the os calcis) may be conveniently divided into two varieties: (1) True; (2) False. The first kind is well illustrated in congenital cases, when the foot is fixed in its deformed position, and the tendons of the muscles that flex the foot on the leg will be found to be contracted, at the same time that the tendo Achillis is elongated. This variety may also be produced by burns, which leave a cicatrix on the anterior surface of the ankle-joint.

The false variety is by far the more common, and is the result of paralysis of the gastrocnemius muscle. In these cases the tendo Achillis is much lengthened, and the dorsum of the foot can be placed on the front of the leg without any resistance being offered; but there is no contraction of the tendons in front of the ankle-joint. The plantar fascia is generally much contracted. This state of deformity is sometimes produced after division of the tendo Achillis, when sufficient care has not been taken in the after-treatment, and the tendon has consequently become too much elongated.

In the congenital cases, a cure may usually be effected without the division of tendons, by rubbing the anterior surface of the ankle-joint with some oily liniment, and stretching the foot away from the leg and retaining it in position by means of a padded flexible iron splint, at the required angle.

The *Treatment* generally adopted for the relief of the paralytic cases is to have a support fixed to the boot so that an elastic band may be placed at the back of the ankle, in order in some degree to compensate for the loss of power in the gastrocnemius muscle. When the plantar fascia is contracted, it should be divided, and the contraction of the sole overcome by means of a Scarpa's shoe, having a divided sole with a cog-wheel, and a strap that can be fixed over the front of the foot. This is necessary, as there is no contracted tendo Achillis to work against, as in cases of ordinary talipes equinus. In the case of contracted cicatrix after a burn, the treatment is the same as in the case of similar cicatrices in other parts of the body.

Talipes Varus (in which the inner edge of the foot is drawn upwards, and the anterior two-thirds of the foot are twisted inwards, and the outer edge rests on the ground) is so seldom met with, apart from talipes equinus, that, to save repetition, it will be considered under the heading of talipes equino-varus.

Talipes Valgus (in which the outer edge of the foot is drawn upwards, so that the patient rests on the inside of his foot and inner ankle) is so generally combined with flat-foot that it will be most convenient to consider them together. The congenital form of valgus is not very common; but when it does occur it is of a somewhat severe type, the sole of the foot being slightly convex, while the foot is held in its deformed position by the peroneus longus and brevis. The treatment of these cases is to stretch the foot towards the position of talipes varus, and to retain it there by means of a flexible splint, bandaged to the inside of the foot and leg. If this is found not to be sufficient to overcome the deformity, the tendons of the peroneus longus and brevis must be divided. When the child begins to walk, a steel sole-plate, with an india-rubber pad fixed to it, must be worn in the boot to support the displaced bones of the tarsus, so that in time the patient may regain the natural arch of the instep.

Cases of paralytic valgus are sometimes met with in which there is no flat-foot, and division of the peronei tendons may or may not be necessary, according to whether they are tightly contracted. In either case, a boot with an iron support attached to the outside of the sole, and with a band round the calf, must be worn, and a leather strap with two ends (T-strap) must be fixed to the inside of the boot just below the internal malleolus. The two ends are buckled round the ankle so as to include the iron support, and these pull the foot into its natural position, and retain it there. In addition to these cases of talipes valgus, either congenital or caused by paralysis, many others of a similar nature are met with in various degrees of severity, from a slight sinking of the arch of the foot, to those in which there is even convexity of the inner border of the sole, and in which the inner malleolus nearly touches the ground. In such cases the foot is firmly held in this deformed position by the contracted tendons of the peroneus longus and brevis, and, in the very worst examples, by the extensor longus digitorum and the peroneus tertius.

These cases, for the most part, begin in growing youths and girls, and are brought to the severer type by constant standing or carrying heavy weights. The treatment depends upon the stage in which the deformity presents itself, and cases may be placed under three heads.

1st. On the patient standing up, the whole of the bottom of the foot will be seen to touch the ground, but little or no valgus will be observed. On examination there will be found to be no stiffness in the ankle-joint, and the foot can be freely moved in all directions. The treatment consists in the use of a boot with a wide and flat heel, into which is placed a steel plate, with a pad attached to its inner border, to press up the fallen arch when the patient stands up upon it. It is necessary that the pad should be fixed to a steel plate, or it will be pushed inwards, and becomes useless.

2nd. In the second class, in addition to the flatness of the foot, its outer side is drawn upwards, and the inner malleolus nearly touches the ground. On manipulation, however, the foot can be inverted without resistance. In the treatment of this kind a sole-plate must be worn, as in the first kind; but, in addition, two cross-straps must be fixed to the inner side of the boot, one passing over the ankle, and the other at the back of the ankle, and buckled over, and just above, the external malleolus.

3rd. In this, the most severe form of talipes valgus, the foot will be found on examination to be in the same position as that just described, but the deformity will be somewhat more marked. The chief difference between them, however, is that the foot is firmly held in its deformed state, so much so that it is sometimes thought to be ankylosed at the ankle-joint, and severe pain is complained of around this joint, especially after standing or walking. On an attempt being made to draw the foot inwards, the tendons of the peroneus longus and brevis, and, in many cases, also the tendons of the extensor longus digitorum and peroneus tertius, will be found rigidly contracted. Although this is the most painful of all forms of club-foot, it is, perhaps, the most satisfactory to treat, for after complete division of the contracted tendons, the foot can be placed without difficulty in its natural position, and, with the use of good boots with sole-plates, the patient is freed from all pain, and able to return to his former occupation. After the tendons mentioned above have been divided, the treatment requires the use of no special instrument, as the necessary extension can be efficiently carried out by means of a padded flexible splint bandaged to the inner side of the leg and foot. If the extensor longus digitorum has been divided, the extension should not be too rapidly proceeded with. The patient may be allowed to walk six weeks after the tenotomy, but it will be necessary that he should wear, as well as a sole-plate, a steel support on the outer side of the leg, with a T-strap, as explained above. *See* Flat-Foot.

Talipes Equino-Varus is that in which the heel is raised, the inner border of the foot being drawn upwards, and the outer edge resting on the ground. The writer proposes to consider it in detail, as it is the most complex, and requires most care and attention in its treatment.

Congenital Talipes Equino-Varus in the Infant differs from that of the adult in that it is less severe, as the foot has not been walked on, and the tendons, ligaments, and fascia have not become so greatly developed and contracted in the deformed position. It will, therefore, be best to consider the treatment of the two forms separately, and to take, first of all, the infantile variety.

The treatment must commence with the cure of the varus, and it is necessary that this should be completely accomplished before anything else is attempted. For it is evident that a simple deformity is more easy to cure than a compound one, and it will be found impossible to overcome the equinus while the varus is still present, for the foot being turned inwards, and the tendo Achillis being shifted to the inner side of the ankle-joint, the attempt to stretch it is made at a mechanical disadvantage, and cannot be satisfactorily accomplished. On the other hand, attempts to stretch the tendons and ligaments which hold the foot in the position of varus are made more advantageously the more the tendo Achillis is contracted; and this is proved by the much greater difficulty that is experienced in the treatment of those cases in which the tendo Achillis has been divided before the tibials, under the mistaken idea that they can be afterwards sufficiently stretched to accomplish a cure. Therefore, it is better to perfectly cure the varus first, and thus produce a case of simple equinus, which can afterwards be readily cured. From the time of birth the foot may be advantageously shampooed, and unfolded, as far as possible, by the nurse; but at the age of six weeks, if the infant is in good health, tenotomy should be practised, and systematic treatment of the deformity begun.

If, in a case of talipes equino-varus, an attempt be made to evert the deformed foot on the leg, and the finger be placed on the inner side of the ankle-joint, the tendon of the tibialis anticus will be readily felt as a tight cord holding the foot in its deformed position. If still greater force be used, and the finger be placed on the inner side of the leg, just behind the edge of the tibia, about an inch above the tip of the malleolus, a slight movement will be felt under the finger, indicating the position of the tendon of the tibialis posticus, more or less distinct according to the extent of the contraction and the amount of subcutaneous fat. Lying very near this is the tendon of the flexor longus digitorum; but this cannot be felt.

The first stage of the operation for the cure of talipes equino-varus consists in the division of these tendons. This having been done—as described in the article on Tenotomy—after the foot has been kept at rest for four days, and the punctures are healed, a flexible splint, six inches long and one inch broad, carefully padded, must be slightly bent so as to make the padded side somewhat concave; it is to be applied to the *outside* of the foot, and bandaged on, so as to draw the foot into a rather straighter position, but not to cause pain to the child. In three or four days the splint is to be taken off, and having been made somewhat straighter, again applied. This is to be continued at about the same interval until the foot can be placed *quite* straight, or, better still, can be bent a little in the direction opposite to that of the original deformity. In ordinary cases this can be accomplished in three weeks.

In the more severe examples of this deformity, however, it will be found that progress cannot be made at such a quick rate. These are the cases in which the heels will be found to be very small and flat, and the foot to have a more rounded appearance than is common. In these cases stretching must be carried out for a longer time, and the foot must occasionally, at intervals of a few days, be suddenly wrenched, either with or without chloroform. When at last the foot can be placed quite straight, it is advisable to keep it in that position for a prolonged time, a month or six weeks, before the treatment is proceeded with.

Having proceeded so far with the case, the sole of the foot should be carefully examined to see if there is any undue contraction of the plantar fascia, and if such be found, the fascia must be divided. In the less severe cases this will not be necessary. In the case of an infant, the tendo Achillis may be divided at the same time.

It is now necessary to decide upon the form of instrument which is to be employed for the further treatment of the case, as this must be measured for, and got ready to be applied, four or five days after the division of the tendo Achillis. If the deformity is not unusually severe, a simple one may be adopted. It is made of sheet-iron, covered with washleather, and consists of a trough for the leg, and a foot-piece at right angles with it, with a leather ankle-strap to keep the heel down, and two webbing straps. One of these is fastened round the leg, and the other goes round the toes and keeps the foot everted. There are no cog-wheels, and, in consequence, this instrument is cheap. Supposing, then, the case to be a simple one, on the fourth or fifth day after the tendo Achillis has been divided, the foot having been bandaged, the instrument is to be applied by thrusting the heel into it, and the leather strap being fixed over the front of the ankle, it is to be drawn as tight as possible and buckled, and the other straps are to be fastened. If the child should suffer much at night, the leather strap may be loosened by one hole and fastened up again in the morning. This, however, is not often necessary, as leather straps always stretch somewhat. Every two or three days the splint must be removed; when the foot will be found to be improved in position, and when the splint is reapplied the leather strap will be able to be tightened by another hole. The heel will also be found to go gradually into its place on the sole-plate of the instrument as this treatment is continued.

After three weeks the splint should be removed every night and morning, and at first the surgeon, and then the nurse, should gently work the foot up and down, care being taken that sufficient force is not used to rupture the newly formed tendon. When this has been done, the splint must be at once replaced, and a thin pad may be placed under the joints of the toes, so that on tightening the heel-strap the foot may be further flexed on the leg. In two or three months the foot will have grown into a natural shape, and move quite freely at the ankle-joint. It should now be left out of the splint for a short time each day, to allow the child to exercise its muscles, and frictions with a simple liniment may be made use of. It must be remembered, however, that in all these cases there is so much danger of relapse that the patient must be watched for the first symptoms of stiffness returning. The child must go on in this way until old enough to walk, and it must then wear irons inside the ankle and leg, and extending round the waist. It is necessary to make the supports extend to the waist, as there is always rotation inwards at the knees, which cannot be overcome by any other means.

In the more severe cases of infantile talipes equino-varus the treatment is the same as that for cases which have been left untreated until after the child can walk.

CONGENITAL TALIPES EQUINO-VARUS AFTER THE PERIOD OF INFANCY.—The treatment of talipes equino-varus, after the period of infancy, may be conveniently divided into three parts: 1st. The cure of the simple infantile varus occasioned only by the contraction of the tibialis posticus, flexor longus digitorum, and the tibialis anticus. 2nd. The cure of the remaining acquired varus, caused by the contraction of the abductor pollicis, plantar fascia, and the various ligaments connected with the misshapen bones of the tarsus. 3rd. The cure of the equinus caused by the contracted tendo Achillis. With regard to the treatment of the first part, the tendons of the tibialis posticus, flexor longus digitorum, and the tibialis anticus must be divided, and after the tenotomy punctures are healed, a wooden, padded, outside splint, extending from the knee to the end of the toes, and with an extra pad just above the external malleolus, must be applied, to which the foot is gradually drawn by means of an ordinary bandage. Great care must be taken lest a sore form on the outer side of the foot, and, if the skin on this part is observed to become red and tender, all pressure must be removed and the splint be discontinued for a day or two. In addition to the gradual stretching by these means, it is well occasionally to *forcibly* twist the foot outwards, and so to rupture any tense fibres of ligament that hold the foot in its deformed position. This treatment must be persevered in until the foot is perfectly straight and in a line with the leg, when the second part may be proceeded with. This is, of all, the most difficult to accomplish even after complete division of the abductor pollicis and the plantar fascia, chiefly on account of the great danger of producing sloughs by such an amount of pressure as will suffice to correct the deformity. The common Scarpa's shoe, useful as it is in some forms of talipes, is quite useless here.

For the efficient application of force in overcoming the resistance formed by the contracted tissues on the concave aspect of the deformed tarsus, the fulcrum must be placed on some part of its convexity, and as near as possible to its most projecting point; the internal tubercle of the os calcis being made a fixed point, and the power being represented by the tension of a strap placed round the ball of the great toe to draw it outwards. The problem, therefore, to be solved is: How can the fulcrum be applied in this position for the required length of time without causing sloughs? The only method is by rendering it a *movable* one. In other words, the pad which forms the fulcrum, instead of being a fixed part of the instrument, should be unconnected with it and thus made capable of being shifted from point to point along the outer edge of the tarsus and leg, as circumstances require. An instrument for carrying this into execution was explained and figured in the *Lancet* of May 3, 1879. One of the chief advantages of this instrument is, that it prevents *rotation* of the foot, and it can also be used for carrying out the third stage of the treatment, viz. correcting the equinus, after the division of the tendo Achillis, by means of a cog-wheel attached behind the heel.

TALIPES EQUINO-VARUS CAUSED BY PARALYSIS, &c.—Although the amount of deformity in each case will be found to vary greatly, from the slightest deviation from the normal state to a condition as severe as in a congenital case, the treatment of these two varieties of club-foot is in many respects identical. Each patient must be carefully examined to determine what are the tendons or fascia that keep the foot in its deformed position. This is done by trying to force the foot into its natural position. In some cases this can be accomplished without any resistance being offered, and then it is only necessary that the patient should wear an *inside* iron and strap. In other cases, on the contrary, the same tendons and fascia which it is necessary to divide in a congenital case must be operated on. It should be remembered that the posterior tibial when contracted, causes equinus as well as varus, and in many cases the former deformity cannot be overcome unless it is properly divided.

In some examples of this deformity, after division of the tendo Achillis, the foot hangs quite loosely at the ankle-joint and with the slightest amount of pressure goes up to the position of calcaneus. When this happens, no special instrument is required for the treatment, but the foot must be kept a sufficiently long time in the position of equinus until the tendon unites, when it must be stretched with great care. This can be done by means of a flexible splint and bandage. In severe cases the details of the treatment are the same as required for congenital cases, and the same instrument must be used.

TALIPES EQUINO-VALGUS (when the foot is turned out and the heel drawn up) is rarely if ever met with as a congenital deformity. In several instances of talipes equinus caused by paralysis, after division of the tendo Achillis, the foot will be observed to have a tendency to turn *out*. This can generally be sufficiently treated by placing an iron on the *outside* of the leg and foot, and having a strap attached to the inside of the boot, passing round it. It must be remembered, however, that the peroneus longus and brevis when contracted can cause equinus as well as valgus, and in some cases it is necessary to divide them.

TALIPES CALCANEO-VARUS (when the heel is depressed and the foot turned in) is a very rare deformity, and requires no separate description.

TALIPES CALCANEO-VALGUS (in which the heel is depressed and the foot turned out). In nearly all cases of talipes calcaneus the foot is more or less turned out. The treatment is generally the same as that made use of for talipes calcaneus. The steel support attached to the boot must be on the *outside* of the leg. HENRY F. BAKER.

CLUB-HAND. *See* HAND, Surgery of the.

CNIDOSIS. *See* URTICARIA.

COCCYDYNIA, a painful and often very obstinate affection of the region of the coccyx, described first by Dr. J. C. Nott, of New York, in 1844, and more fully by Sir James Simpson in 1859. Its marked symptom is severe neuralgic pain, radiating from the sacro-coccygeal joint, and like in its intensity and its general effects to the pain caused by fissure of the anus. It is due in many instances to some slight injury occurring during delivery, or to some uterine or ovarian disturbance, and therefore is most frequently met with in women. In some few cases, however, it has been observed in men and also in young children. It may be caused by displacement of the coccyx either backwards or forwards, by injury to this region causing a sprain, by excessive horse-exercise, or simply by the application of cold to the region. In a well-marked case the patient suffers much from constant pain, with paroxysmal attacks of almost intolerable suffering, and is obliged when sitting to rest the weight of the body on one or the other tuber ischii, and often is unable to walk or even to stand upright. The affection in some instances is a very transient one, and in others persists in spite of varied and active treatment. For the treatment of the latter class of cases, Sir James Simpson recommended subcutaneous division of all the muscles connected with the coccyx. This operation has been practised with some success; but in most instances the affection remains intractable, and neither myotomy nor extirpation of the coccyx, a method devised by Dr. Nott, can afford any decided benefit.

W. Johnson Smith.

COCCYX, Dislocations of the, are generally of an incomplete kind. They may occur *backwards*, as the result of parturition, or *forwards*, from kicks or falls in a sitting posture. Reduction is easily effected by pressure, the finger being placed in the rectum to reduce the forward displacement. Prolonged coccydynia is apt to follow, owing to the impossibility of securing complete rest, and to the implication of the nerves in the inflammatory thickening which results.

R. Clement Lucas.

COCK'S OPERATION. *See* Boutonnière, the Operation of.

COLD is a therapeutic agent of varied and great usefulness in the surgeon's hands. It may be applied in the moist or dry state,—alone, or in combination with other remedial measures.

Cold acts, according to the manner and degree of its application, as an *anæsthetic*, *antiphlogistic*, *antiseptic*, *hæmostatic*, or *tonic*. The anæsthetic power of cold is due to the numbness and insensibility which attend the freezing of living tissues. The simplest method of securing that result is to crush a piece of ice in a cloth, by blows with a mallet, or by a tread under the heel of the boot; then, adding to the ice about half its weight of salt, to hold the mixture in a muslin bag on the part to be rendered insensible. A more elegant method is that suggested by Dr. B. Richardson—a hand-ball spray, and pure anhydrous ether. Tissues so frozen may be cut painlessly, but their hardened state is inconvenient if any fine dissection be required.

The antiphlogistic power of cold, long and justly in repute, has been greatly extended since it has become the practice to apply ice in india-rubber bags. Professor Esmarch, the leading advocate of this treatment, has thus expressed himself:—'Of all remedies which are at our command in the treatment, of inflammatory processes, cold is the most important; without this remedy he would rather not be a surgeon.' The two great features in the inflammatory process are, increased afflux of blood and rise in temperature; and it is by controlling these, physically and vitally, that cold exercises its antiphlogistic power, all the more effectually when combined with position and rest.

Injuries of the head, which are so greatly benefited by cold, offer wide scope for ingenuity in practical details, applicable to other parts of the body. Nothing can be more effectual than pounded ice in an india-rubber bag, which may be suspended by a tape or bandage, to secure contact with the scalp without oppressive weight. In the absence of an india-rubber bag, the bladder of an ox or large pig answers the purpose; but as the animal membrane is a superior conductor, it lowers the temperature of the part and melts the ice more quickly than when it is enclosed in an india-rubber bag. Hence, ice in animal membranes requires closer watching and more frequent renewal, to ensure the great requisites of comfort, continuity, and safety. In the absence of a bladder the head may be cooled by wetting it lightly from time to time with water, alone or mixed with spirit, and blowing on it with the mouth, a fan, or bellows, to accelerate evaporation. To keep the patient comfortable and at rest, while cold is being applied, the bed and pillows should be kept dry with waterproof sheeting, linen cloths, or absorbent tissue. In some cases, especially in strangulated hernia and swollen joints, the even pressure of a well-adjusted ice-bag adds greatly to the efficacy of cold, which may be applied by other methods, e.g. coils of india-rubber tubing, Leiter's metallic coil, irrigation in a variety of ways based on syphon action; water, snow, or pounded ice in bottles; or metal cases which may be made to fit any part, after moulded patterns.

In the absence of spinal appliances, it is well to bear in mind the simple teaching of Abernethy:—'Wetting the surface of the skin, whilst it is freely exposed to the air, by passing a sponge dipped in common water over it at regular intervals, and thus maintaining constant evaporation, is one of the most powerful of all the modes of reducing temperature.'

A very useful cold lotion may be prepared by dissolving in a pint of water half an ounce of nitre, two drachms of sal ammoniac, and three tablespoonfuls of vinegar, or methylated spirits of wine. By increasing the proportions of nitre and sal ammoniac to five ounces each in the pint of water, a frigorific mixture is produced, which, on emergency, acts as a good substitute for ice. To make an *ice poultice*—of special value in the treatment of thoracic and abdominal injuries—spread a layer of linseed, about an inch thick, on a piece of cloth or absorbent tissue; on it, at regular intervals of an inch or more, place lumps of ice about the size of small walnuts, sprinkle with meal, cover with another cloth, and fold in the edges ready for application. The general preference to which dry cold is entitled, is exceptionally established when it is deemed advisable to apply cold outside bandages. If these be wetted after application they may shrink, so as to produce an amount of constriction which has been known to result in gangrene of the subjacent parts.

The *antiseptic* power of cold is a corollary of its antiphlogistic influence, and is most marked when dry cold is used. Warmth and moisture are powerful factors in animal putrefaction, to which by parity of reasoning, confirmed by experience, cold and dryness are opposed. So, too, by stimulating the contractility of the vascular coats, cold acts as a hæmostatic, all the more effectually if associated with the elevated position, to retard the arterial, and accelerate the venous, current.

Of the tonic action of cold, bathing supplies abundant evidence. Patients suffering from piles, varicocele, and generally from weakness in the pelvic regions, often derive very great benefit from cold hip-baths and enemata. Cold to the face and hands is a popular reviver from faints, and deservedly so. A greater degree of cold, than by affusion with water, may be produced by sprinkling ether or eau de Cologne in the palms of the hands, or on the forehead and behind the ears, and blowing on it, to accelerate evaporation. In extreme fainting, from the effects of chloroform or other cause, a lump of ice, the size of a pullet's egg, pressed into the rectum has been known to excite a deep inspiration, and at once revive an apparently moribund person.

Sampson Gamgee.

COLECTOMY.—When resection is practised upon the colon, the proceedings are practically identical with those described under Enterectomy. In colectomy the chief difficulty lies in the selection of the incision through the abdominal parietes. When the obstruction is distinctly diagnosed to be in the ascending or descending colon, no incision is better than that practised for lumbar colotomy. When the obstruction is diagnosed to be situated in the transverse colon, sigmoid flexure, or cæcum, the parietal incision may be made directly over the seat of the occlusion. When the locality of the obstruction cannot be directly determined, an exploratory incision should be made in the middle line. If the resection can be performed through this median incision, it is well. If found to be impossible, the median wound should be closed, and a second incision made in one or other loin, or more directly over the seat of the obstruction. The observations made with regard to the selection of the mode of resection when dealing with enterectomy, apply equally to the operation when performed upon the colon.

The general mortality of resection operations, as estimated from some 130 reported cases, is about fifty per cent.

Frederick Treves.

COLLAPSE is a state of lowered vitality, induced by reflex inhibition, affecting all the functions of the nervous system.

Causes.—1. *Injuries*, sudden and severe, e.g. burns and scalds, the crushing or mangling of a limb, capital operations, lacerations of any large viscus, severe blows on the abdomen or precordial region without any definite lesion. An injury may cause severe shock, irrespective of the pain produced, as is evidenced by operations performed under anæsthetics.

2. Pain, especially when in connection with parts supplied by the sympathetic nerve; thus shock is often considerable in renal or hepatic colic, or in hernia at the moment that strangulation takes place.

3. Hæmorrhage is a great cause of shock. Up to a certain indefinite amount

a patient is able to lose blood without suffering from shock; but when this amount is once exceeded, symptoms of collapse rapidly supervene. Hæmorrhage, even if but slight, is attended by much more serious consequences at the extremes of life than in the middle-aged, also in the anæmic than in the robust.

4. Mental emotion, e.g. sudden fright.

5. Sudden withdrawal of part of the abdominal contents, as by tapping for ascites, emptying of a hyperdistended bladder, occasionally the use of drastic purgatives.

These causes do not act equally on all patients or under all circumstances. Thus, extensive injuries are much more readily borne by children than by adults, by the healthy and vigorous than by the debilitated and diseased. Pain, on the other hand, is very badly borne by children, in whom it is perhaps the most important agent in inducing shock. The state of mind of the patient at the time of injury, exercises an important influence. If he be greatly excited, and his mind preoccupied, the pain felt will be but little, and the shock induced by the *pain* proportionately small. Nevertheless, under such circumstances, the shock induced by the severity and amount of the *injury* is but little lessened, though its oncoming is sometimes postponed. If, however, the mind be in a state of expectancy or dread of the coming danger —for example, if a patient has made up his mind that an operation is likely to prove fatal—shock is proportionately great. The *impression* produced on the patient's mind by the suddenness of the accident, by the tearing and mangling of a limb whilst he is painfully conscious of the mutilation that is taking place, by the sudden transition from an active life to lengthy confinement in bed, greatly increases the amount and intensity of the shock, due probably in part also to loss of blood; and it is on this account that a primary amputation—e.g. of the thigh, for a compound fracture of the leg—is accompanied by infinitely greater shock than a precisely similar operation performed for disease.

Pathology.—The state of shock or collapse is induced by a 'reflex inhibition affecting all the functions of the nervous system,' i.e. for the time being, the influence of the nervous system on the life of the various tissues and organs of the body is suspended to a greater or lesser extent. The various senses are all more or less affected—sight, smell, hearing, touch, and mental power being variously influenced. But it is to the interference with the nervous mechanism of the heart that most of the symptoms—and those the most serious — are due. For, whilst a patient may readily survive any interference with the sense of sight, touch, &c., a sudden slowing, or even stoppage, of the cardiac contractions will cause death, either suddenly or in a comparatively short time. The stopping, or slowing and weakening, of the cardiac contractions is probably due both to a direct influence exercised through the cardiac nerves themselves, and also to the effects of a diminished blood-pressure induced by the loss of tone in the peripheral arteries, through interference with their innervation. The post-mortem appearances after death from shock are slight, but the veins are usually turgid, and, except in cases of hæmorrhage, all the cavities of the heart are full of blood. Rigor mortis is slight, and the blood generally imperfectly coagulated. In death from the collapse induced by severe hæmorrhage, however, the vessels contain but little blood, and the various organs are of a much whiter hue than normal.

Symptoms.—In severe shock the patient is often completely unconscious for a time; and, even though moving his limbs, and with eyes open, may be quite unable to understand anything that is going on around. In cases of less severity, he cannot readily appreciate the meaning of questions, is quite unable to recall to his recollection facts of which he is really well aware, such as his own name or residence; and in yet other cases, whilst answering questions correctly, his memory appears to be lethargic, and his answers are delayed for five or ten seconds or more. The functions of his various organs are in abeyance, his sight is dim, and he feels giddy, there is a humming noise in his ears, he articulates with difficulty, his sense of touch is greatly impaired, he lies in a state of complete prostration, his muscles are powerless to move his limbs, his sphincters may be paralysed, and his eyelids droop. The skin is livid and clammy, the surface temperature, and perhaps that of the whole body, is distinctly lowered. The movements of respiration are very shallow and feeble, occasionally gasping. The pulse is generally frequent and very feeble, often irregular and dicrotous; the sounds of the heart are but faintly heard. In such a condition as this the patient may die within a very short time from the receipt of the original injury; but in other cases, not immediately fatal, where reaction does not take place (*see* Reaction), this state of shock may be prolonged in some of its features for several days, the patient remaining depressed, and never rallying up to the time of his death.

The chief distinction between the symptoms of the collapse induced by hæmorrhage and those induced by injuries unaccompanied by excessive loss of blood is, that in the former the mental functions are but little affected in comparison with the amount of asthenia, and that the skin is white and bloodless instead of livid, as in the latter.

Treatment.—The chief object of treatment is to restore, as rapidly as possible, the functions of the heart and vessels. In order that the heart may act with as little extra labour as possible, the patient must be kept in the recumbent position, and, that the brain may receive sufficient blood, the head must be kept low, and, in bad cases, blood kept from entering the lower extremities by tight bandaging, or by the application of tourniquets to the femoral arteries for a short time. The failing body-temperature must be sustained by wrapping in cotton wool or warm blankets. Cardiac stimulants must be administered. Chief of these is brandy, in quantities not exceeding half an ounce at a time, and the total amount not exceeding three or four ounces during the continuance of the more severe symptoms, for, if these precautions be not taken, vomiting is likely to ensue. In addition to this, and in its place if the patient is unable to swallow, the brandy may be administered as an enema, or ten to fifteen minims of ether may be subcutaneously injected. Hot milk and strong coffee are often useful. Hot fomentations or mustard-blisters should be applied to the feet, and to the epigastric region. In order to further strengthen the cardiac action, digitalis (liquid extract fʒj.), strychnia (liquor. strych. ♏v.), or belladonna (tinct. bell. ♏xx.), may be given, together with the brandy. If pain be a marked symptom—e.g. in burns in children—opium may be administered with excellent results. As soon as the patient can take further nourishment, this should be supplied, at first in but small quantities, and of such a nature as to ensure rapid assimilation—strong beef-tea and essence of beef. Alcohol should be dispensed with as soon as possible, especially where great reaction or traumatic fever is to be expected. In cases of severe injury, where a capital operation is necessary, the patient should be allowed to rally from the extreme collapse, though it is not necessary, or indeed practicable in most cases, to wait for complete reaction. It is in such a condition—generally reached, if at all, within five or six hours (or less), from the time of the accident—that the additional shock of the operation makes the least impression on the system, whilst if the patient die before such a state is reached, the surgeon may congratulate himself on having stayed his hand.

In cases of operations of expediency for long-existing disease, shock may be much lessened by rest in bed and careful attention to the diet for a week or more beforehand.

Anthony A. Bowlby.

COLLES' FRACTURE. *See* Radius, Fractures of the.

COLLODION is a colourless, viscid liquid, produced by dissolving gun-cotton in three-fourths ether and one-fourth rectified spirit. When this compound is spread on the skin rapid evaporation takes place, leaving a dry, adhesive, impermeable, and contractile layer. These physical properties, and its chemical composition, render collodion a very useful antiphlogistic and antiseptic, powerfully instrumental in maintaining rest and exercising equable pressure. Successive layers of collodion, spread with a camel's-hair pencil, and alternated with layers of absorbent muslin, make well-moulded splints, very useful in fractures or wounds of the hand, and exceptionally so in the management of fractures of the nose.

Small wounds do very well under collodion; but, before applying it, all dirt should be removed and bleeding stopped. In larger wounds, strips of gauze or lint, or skeins of cotton, soaked in collodion, and placed like adhesive plaster, are superior to these in assisting sutures to maintain accurate apposition. In removing collodion dressings with the minimum of disturbance, it is important to bear in mind that they are insoluble in water, but very readily so in a mixture of equal parts of ether and alcohol. In an emergency, a little brandy or whisky will be found to soften the dressings, all the more agreeably if previously warmed. In the treatment of swelled testicle and subcutaneous extravasations of blood, collodion is very useful; so also in limited cases of erysipelas, in chilblains, and sore nipples. For these purposes some surgeons give preference to flexile collodion, prepared by adding two drachms of Canada balsam and one drachm of castor oil, or glycerine, to six ounces of collodion. The difference is not very material. In either form, the agent admits of very varied and useful application. Sampson Gamgee.

COLLOID CARCINOMA. *See* Carcinoma.

COLOBOMA. *See* Choroid; Iris.

COLOTOMY.—This operation consists in establishing an artificial anus in the bowel, above the seat of some obstruction. It has been performed in all forms of occlusion of the colon, in cases of simple and malignant stricture, in cases of occlusion of the bowel from simple neoplasms, from the pressure of a tumour external to the gut, from enteroliths and plugging by foreign substances, and from bending of the colon or distortion thereof due to adhesions. It has been practised also in cases of colic intussusception, in volvulus, and in instances where a fistula exists in the bowel which communicates with the bladder, vagina, &c. Colotomy has been performed also to relieve the distress consequent upon the passage of fæcal matter over a cancerous ulcer of the bowel, in instances where no real obstruction existed.

There are two forms of colotomy, lumbar and inguinal; the former is commonly called Amussat's operation and the latter Littre's. In the former the ascending or descending colon is opened in the loin, without wound of the peritoneum. In the latter the cæcum or sigmoid flexure is opened through an incision in the iliac region, which involves a wound of the peritoneum. *See* Atresia Ani. Lumbar colotomy is best performed upon the left side, since the descending colon is more fixed than the ascending, has a larger non-peritoneal surface, is less frequently the seat of abnormality, is less often provided with a meso-colon, and involves an artificial anus that is nearer to the natural anus. It happens also that strictures of the colon are much more frequent in the rectum and sigmoid flexure than in any other part of the large intestine.

The operation is thus performed, presuming that the descending colon has to be opened. The proceeding, however, is the same if the right side of the body be selected. The patient is placed upon the right side, and a hard pillow is placed beneath the right loin, so as to render the left loin more prominent. From the centre of the crest of the ilium, a line is drawn with ink vertically upwards to the last rib, which it will touch near its free extremity. An incision, four inches in length, is then made across the line, at right angles to it, and so arranged that the centre of the incision corresponds to the centre of the line. The wound is therefore midway between the iliac crest and the last rib. Amussat advised a vertical incision which corresponded pretty nearly to the aforesaid ink line. The proceeding has, however, been very generally abandoned. Mr. Bryant uses an oblique incision, 'four or five inches long, beginning one and a half inches to the left of the spine, below the last rib, and passing downwards and forwards in front of the anterior spine of the crest of the ilium, with the line of the incision passing obliquely across the external border of the quadratus lumborum about its centre, and taking the same direction as the nerves which traverse this part.' In the transverse wound after the skin and subcutaneous tissues have been divided, the latissimus dorsi muscle is exposed in the incision with a small amount of the external oblique. On dividing this layer, the internal oblique muscle is exposed in the whole length of the wound. When this structure has been cut through, the posterior aponeurosis of the transversalis muscle (fascia lumborum) is exposed, and in the posterior part the anterior edge of the quadratus lumborum. As a rule the latter muscle does not require division.

After the aponeurosis of the transversalis has been divided upon a director, even in the most emaciated patients, a quantity of loose fat comes into view in which the kidney is embedded. On tearing this gently away in the position of the colon, the transversalis fascia is exposed. This structure should be cautiously torn through by means of two pairs of forceps. Its strength varies very much, and it is apt to be mistaken for the peritoneum. The bleeding, so far, is as a rule very trifling, and any hæmorrhage may be checked by torsion. If the region of the quadratus be encroached upon by the knife, a lumbar artery may be divided. The finger should now be introduced into the wound, and the position of the kidney, which lies behind the bowel, made out. The finger should then be passed into the angle between the psoas and quadratus lumborum muscles. The non-peritoneal surface of the colon looks into this angle, and if, while the finger be held in this position the patient be rolled a little over to the left side, the gut which comes into contact with the digit must be the descending colon. The bowel should now be hooked forward into the wound, and an attempt made to expose that surface which faces the angle just mentioned. When the bowel is much distended, it will protrude into the wound as soon as the tranversalis aponeurosis is divided, and the procedure just named is not necessary. Some surgeons distend the colon by air, or by injections of fluid, before the operation is commenced; but the measure is seldom necessary. 'A large curved needle, carrying stout silk, is then to be passed through the skin to one side of the ink mark, across the bowel, and through the skin at a corresponding point on the other side of the mark, and the entire proceeding is to be repeated at the other end of the incision. The colon is thus fixed before being opened, and is held in place by the threads, which are grasped by assistants. It only remains now to open the intestine, and this is best done midway between the two threads by a small longitudinal incision, which may be cautiously enlarged so as to be about one and a half inch in length. The finger passed into the bowel can now draw out each loop of thread by which it is transfixed, and these being divided will give four threads already passed through skin and intestine, and only requiring to be tied. The anterior and posterior extremities of the wound should afterwards be drawn together with two stitches, and the operation is completed' (Heath).

As regards after-treatment, the skin about the wound should be kept carefully oiled, and the parts protected by a large pad of 'tenax.' The stitches may be removed at the end of six or seven days, or may be allowed to cut their own way out. When the parts are consolidated, it is well to gently introduce a tube into the bowel below the fistula, and wash out the fæcal matter contained therein, since the retention of such matter often gives rise to much inconvenience. When the case is not urgent, it is well to perform the operation by two stages, the first of which may be done antiseptically. In the first stage the gut is exposed and secured to the wound by sutures which only penetrate the muscular coat. The bowel is not opened. At the end of a few days, when the gut has acquired firm adhesions to the margins of the wound, the antiseptic dressings may be left off, and the artificial anus established. In this way the extensive suppuration that sometimes follows the escape of fæces into the subserous or inter-muscular connective tissues, may be avoided; the evils of an accidental opening of the peritoneal cavity are reduced to a minimum, and the healing of the wound is greatly hastened. To avoid the trouble consequent upon the accumulation of fæces in the bowel below the artificial anus, Madelung proposes to empty this segment of the gut of its contents, and then entirely close the end of the intestine below the abnormal opening.

In *Inguinal Colotomy* the abdomen is opened by an incision about three inches in length, which is made parallel to and just above Poupart's ligament; the inner end of the incision being just external to the deep epigastric artery. The bowel, having been exposed, is secured to the margins of the wound by the same means as in lumbar colotomy. The great disadvantages of this operation are the less convenient position of the artificial anus, and the fact that it involves an opening into the abdominal cavity. Erckelen's statistics, which deal with 262 examples of colotomy, show that the mortality after all forms of colotomy, taken together, is about 54·2 per cent.; the mortality after Amussat's operation is 38·4 per cent.; and after Littre's, 46·4 per cent.

Frederick Treves.

COLOUR-BLINDNESS. — Colour-blindness may be either congenital or acquired. The congenitally colour-blind, though possessing perfect sight for form, are unable to appreciate some differences in colour which are obvious to others. The three colours principally concerned in well-marked congenital colour-defects are red, green, and violet. Light of these three colours when combined by mirrors, by two overlapping spectra, or on a rotating disc will appear to a normal eye white or grey. These three colours are, moreover, peculiar, in that they are the only ones which cannot be produced by the mixture of other spectral colours. They are therefore called fundamental colours. While normal vision appreciates these three fundamental colours in the spectrum, and, in addition, certain others, yellow and blue, between them (omitting the orange), most congenitally colour-blind persons appreciate only *two* fundamental colours. Their vision is consequently said to be dichromic.

But there are very rare cases in which one colour only is appreciated in the spectrum, whose various parts consequently appear different only in their degrees of brightness. Achromatopsia is the term applied to such a defect. Those above referred to as possessing a dichromic system are said to suffer from *partial* achromatopsia.

Total colour-blindness (achromatopsia) is very rare, occurring perhaps once among ten thousand men. We are unable to say exactly how things appear to the totally colour-blind, whether, for example, in shades of grey, from white to black, like a photograph to us, or in various shades of one of the fundamental colours, such as, for example, violet. A total colour-blind would pick out coloured wools indiscriminately, except for the different amounts of light which different colours reflect. The defect may be completely developed, or a feeble perception of all three fundamental colours may still exist. It is very questionable whether total achromatopsia ever occurs, unless in association with other ocular defect. It is usually observed that, in association with some defect for form, the disc is white, or there is nystagmus or photophobia. Partial colour-blindness (partial achromatopsia) occurs more commonly. It does not appear to be necessarily associated with anything pathological, since the sight for form amounts to about the average.

One of the fundamental colours is wanting entirely or in part to the partially colour-blind. Their colour system is therefore dichromic. Occasionally violet is the defective colour. In such cases the sufferer would appreciate only two out of the three fundamental colours that are normally visible in the spectrum. Whereas we see *on the left* red, followed by orange, yellow, green, blue, and violet, he would see only one *to the right*, representing violet, blue, and green, and one only *to the left*, representing the red and orange, his two colours being separated by a grey band which occupies the position of the yellow. Consequently he will mistake—unless, indeed, he can guess at them by the relative degrees of brightness with which they are associated in his mind—green, blue, and violet for each other, but he will sharply distinguish them from red and orange. Violet would be a darker shade to him than to us, so that dark violet would be undistinguishable by him from black, and the extreme right hand of the spectrum would be shortened. Such cases are extremely rare, perhaps 1 in 10,000 men, and on this account, and from the nature of the colour concerned, are of less practical importance than those next to be described. It is said that the drug santonine will produce temporary violet-blindness.

The great majority of partial colour-blinds are defective to red and green, and consequently their defect has received the name of red-green blindness. The spectrum is divided to them by a narrow grey band where the green and blue shade into each other. All to the *left*—viz., the red, yellow, and green—appears of the same colour, though of vastly different shade in its different parts; and all to the *right*—viz. blue and violet—of another strongly contrasted colour. The yellow is far brighter to them, as to us, than the neighbouring red and green. Consequently they are not liable to confuse yellow with either red or green. But the two latter, being far nearer in shade, are liable to be mistaken for each other.

Red-green-blindness is undoubtedly divisible into two varieties, of which the one is called *red-blindness*, and the other *green-blindness*. It is difficult to say how these colours really appear to the red- or green-blind; but, judging from rare cases of colour-blindness in one eye only and from other evidence, it is not unlikely that to the *green-blind* all to the left of the blue and violet (which appear as blue) is represented *at its brightest part* by yellow, just as to us, shading off on either side into a much duller reddish hue, which is slightly darker to the *right*—that is to say, in the green than to the left, i.e. in the red. Their two fundamental colours, speaking generally, will thus be blue and some variety of red, and the two will be separated by a narrow belt of neutral or grey colour. Though they will never match yellow, whether in the spectrum or in pigments, with green or red, they will be liable to confuse the two latter colours. But to match a vivid scarlet they will pick out a green lightened by some slight admixture of yellow, and they will see bluish-green and grey alike.

Similarly, to the *red-blind* all to the *left* of the spectrum is represented by yellow, shading off into a greenish colour, which is much darker in the red than in the green region of the spectrum. Indeed, the extreme left-hand end of the spectrum cannot be distinguished from black by the red-blind. It is as if the brightness of the left-hand part of the spectrum were shifted rather towards the right, and with it the dividing band between the blue and their other colour, whereas in green-blindness it is moved, though to a much less extent, the reverse way. Consequently the red-blind will match a scarlet with a dark green and with a dark brown.

It is obvious, from what has been said, that the detection of physiological colour-blindness is not so very simple a matter as it would at first sight appear. Even a total colour-blind—i.e. one to whom differently coloured objects appear simply as various shades of one colour, as does a photograph to us—will not match yellow with an average blue or even with a red, since the three appear of quite different shades, from the brightest, the yellow, to the darkest, the blue. In the same way a red-blind would not match an average red with an average green, the first appearing to him much darker than the other. But if coloured surfaces or coloured lights of exactly corresponding shades to him were presented, he would be totally unable to distinguish them. All tests of colour-vision are on this principle. The most scientific is doubtless by the use of the double spectroscope. But others, which are more easily and conveniently applied, suffice for all practical purposes.

The coloured wools which pass under Holmgren's name show a large number of shades of differently coloured woollen skeins.

The person to be tested is given a skein of a pure pale green colour; *pale* because many will fail at this who would be successful with a stronger colour, and *green* because it is a defective colour, not only to the red- and green-blind, but also to the violet-blind. He is asked to pick out all the skeins which seem to him like the sample given or, perhaps better, all which contain some of that colour, little or much. It is important that the colour should not be named, otherwise an ignorance of the names of colours may possibly be mistaken for colour-blindness. If his colour-vision be defective, he will pick out other colours as well as various shades of green; for example, greys, browns, pinks, or blues and violets. This alone is sufficient to demonstrate the fact of colour-blindness. If we want to know something as to its degree and kind, we may go further. If he has selected greys, browns, or pinks to match with the green, he is probably red- or green-blind. If then, a pale rose-coloured skein—i.e. a mixture of blue and red—be given him, he will, if red-blind, pick out dark blue and violet to match with it, the red being to him little more than a darkening shade. If, on the other hand, he be green-blind, the rose will be to him more of a neutral tint, and he will match it with grey and with bluish-green. If he is offered a scarlet he will match it, if red-blind, with a green or brown which appears to a normal eye much darker; whereas, if he be green-blind he will match it with a light brown or with a green lightened with some slight admixture of yellow. If his failures do not extend beyond the first test, excluding violet-blindness, he is called an incomplete partial colour-blind.

The coloured squares of 'Ole Bull' are on the same principle, but here red, green, blue, yellow, and grey squares, 10mm. in diameter, are arranged in rows from the faintest—i.e. the first—down to the most intense, the tenth row. The colours of each row, from the strongest upwards, are successively diluted by admixture with grey, so that those of each row, while being all of exactly the same shade, are of less intense colour than the row below them. Consequently the colour-blind will readily mistake the colours of the various rows; and the amount of his defect will be judged by the faintest row he is able to indicate correctly. The colours of the first row are recognisable by the normal eye at 1 metre distance in good light. The patient is shown the grey square, and asked to name the other colours of the first row. If he fail at this, squares in other rows below are successively indicated. If, for example, he can do only the one marked No. 6, his colour-vision will amount to one-sixth only. The test is therefore quantitative, and in this respect it excels that by coloured wools. It is also, as will be seen presently, better adapted for most pathological colour-defects.

What is called the shadow test is interesting. If an object be illuminated by two lights, one coloured and the other an ordinary light or colourless, the shadow cast on the coloured ground by any object, such as a pencil, takes by contrast the complementary colour. Thus, if the light be red, the pencil will throw one shadow from the ordinary light, which will appear red, and one from the red light, which will appear green. But to the red- and green-blind the complementary colour is not recognisable.

The pseudo-isochromatic tables of Stilling are on the same principle. Letters of one colour are printed on a background liable to be confused with it. But, in consequence of the great difficulties in making lithographic colours present a similar surface as to smoothness and brightness, as well as exactly the same shade, the test is of little practical use.

Donders has arranged certain quantitative tests. They consist of small circular coloured spots of different sizes attached to a surface of black velvet. The normal distance having been previously carefully determined by experiment, the distance at which the candidate can recognise them is noted. A spot of red or green should be recognised in good daylight at 5 metres (about 16 feet). Similarly, discs of coloured glass are presented in front of a light successively, by aid of a revolving disc. Since ordinary coloured paper or glass rarely approaches a pure colour, the material for this test requires great care in its selection. These tests of

Donders are, on the whole, best adapted for determining the fitness of railway-drivers or look-out men at sea for their work.

Colour-blindness exists to a greater or less extent in about 4 per cent. of men. In women it is at least ten times as infrequent, and even correspondingly less in degree. It is slightly less common in the upper—that is to say, the more educated—classes of life, than among ordinary people. Education will, however, do nothing for its removal, and, so far as we know, nothing for its prevention in the individual. We can only speculate why it is less common in women. It is very liable to be transmitted by inheritance, perhaps as much through the mother, though she so rarely manifests it herself, as through the father. After total achromatopsia violet-blindness is the most rare, perhaps amounting to $\frac{1}{2}$ per cent. in men. Consequently defects to red and green are far more important, not only on account of their greater frequency (about 3·5 per cent.), but because lights of these colours are universally used as signals. Indeed, any other colours would be quite unsuitable. Yellow would be liable to be mistaken for an ordinary light, and blue, being much duller than any ordinary yellow, would be visible at a much shorter distance, and so could not be opposed to it. The importance of colour-blindness in relation to coloured signals reaches its maximum in the case of the red-blind, to whom a red light appears far darker than the green. Indeed, it is so much darker to him than to the normal eye that he cannot recognise it at all, even as a light, till within a much shorter distance than normal. If the two were contrasted at a short distance only, he would consequently see both, and distinguish them by their relative brightness. But if either were exhibited at a distance, and under conditions of brightness previously unknown to him, as at sea, he would be utterly unable to recognise its colour. The peripheral parts of the retina are normally less sensitive to certain colours than to others. If red and green spots be presented under ordinary daylight at the periphery of the visual field, their colour cannot be distinguished, whereas blue and even yellow can be perfectly recognised.

Acquired colour-defects are also important, both in their relation to coloured signals and as symptoms of certain diseases, such being atrophy of the optic nerve, both primary, as from tobacco and alcohol poisoning, and secondary to more general conditions, such as locomotor ataxia and disseminated sclerosis. Green and red are the first colours to go, the former being usually called white and the latter brown; or the two colours are undistinguishable. In tobacco and alcohol amblyopia the loss is at first limited to the immediate neighbourhood of the point of fixation (central colour scotoma), so that the patient, though he can recognise small spots of these colours when held somewhat laterally in any direction from his point of central vision, fails to recognise them when moved to the centre. This failure may be partial, in which case the colours are seen less vividly, red as brown, for example (relative scotoma), or total, in which case he sees the spot of no *colour* at all (absolute scotoma). *See* AMBLYOPIA.

But in other diseases, such as the atrophy of locomotor ataxia and disseminated sclerosis above mentioned, and the atrophy that sometimes follows blows on the head or typhoid fever, appreciation of red and green becomes entirely lost, or all perception of colour may be permanently gone. A complete loss of all colour-vision may occur temporarily in hysteria.

It is in the highest degree questionable whether an acquired defect for red and green ever exists without some loss of central acuity for form, but it is certain that colour may fade in undue proportion to form, especially in tobacco amblyopia. Consequently a patient suffering from this affection may go about and carry on all his other duties perfectly well, and still be totally incapable of distinguishing a red from a green signal right before him. It is probable that acquired colour-blindness is even more important in respect to signals than the congenital form, since the sufferer has had, in the former case, little time or, indeed, opportunity to recognise his defect, occurring almost invariably, as it does, between forty and sixty years of age; and he being able, in early cases of tobacco and alcohol poisoning, still to recognise colours in the circumstances under which they are usually presented in every-day life.

From what has been said it will be evident that certain acquired defects of colour will escape detection by Holmgren's coloured wools. It needs the use of the coloured discs of Donders or of 'Ole Bull,' or, perhaps better than either, of red and green squares, 10mm. and less in diameter, mounted on a black card, which may be conveniently supported on a handle. The examination may be made, either by the patient fixing the corresponding eye of the observer at a distance of a foot, or by the use of the perimeter.

W. A. BRAILEY.

COMA. *See* HEAD-INJURIES.

COMEDO.—*Definition.*—A collection of sebum distending beyond its normal limits a sebaceous gland, the external aperture of which remains patent.

Symptoms.–Comedones form at or about puberty, when the hair-follicles of certain regions are in active development. The sebaceous glands enlarge and secrete more sebum than can be expelled from the mouth of the follicle.

People with coarse skin and feeble circulation and a scanty growth of hair are most prone to them. The forehead, nose, cheeks, chin, inside the ears, the chest, back, and neck, are the parts commonly affected, and they rarely occur elsewhere. Sometimes they are congenital. They appear as yellow or black specks on the skin, slightly raised, which, when squeezed, eject a long worm-shaped mass, consisting of sebaceous matter, and in its substance there is occasionally found a minute grub. *See* Acarus Folliculorum. The elongated shape of the mass is the result of its having been squeezed through the narrow neck of the follicle. Some think the black on the surface is due to dirt solely, others trace it to pigment. When, as is often the case, the comedones become inflamed, acne vulgaris is produced.

Treatment.—Where there is a tendency to the development of comedones it is well to wash several times daily with hot soap and water, using at the same time much friction with a rough towel. All the spots should be squeezed and the matter forcibly removed, and, to prevent the sacs refilling, it is necessary to insert a needle and scarify the lining membrane, which will have the effect of completely obliterating them. Lotions or liniments containing soap and spirit are most useful, to dissolve the sebaceous matter and to stimulate the capillary circulation. The following is a good formula: ℞ Sapo mollis, ℥j.; Eau de Cologne, f℥jss.; Sp. vini rect. f℥ij.; Aq. sambuci ad f℥vj.; fiat lotio. To be used twice a week at bed-time. Mildly stimulating ointments containing small quantities of either sulphur or tar are also of value. Internal remedies should be employed if there is any irregularity of the digestive organs or other functional disturbance.

Malcolm Morris.

COMPRESS. *See* Pressure.

COMPRESSION. *See* Pressure.

COMPRESSION OF THE BRAIN. *See* Brain, Compression of the.

CONCUSSION OF THE BRAIN. *See* Brain, Concussion of the.

CONCUSSION OF THE SPINAL CORD. *See* Back and Spine, Injuries of the.

CONDYLOMA. *See* Mucous Patch; Syphilis; Warts.

CONGENITAL DEFORMITIES. *See* Atresia Ani; Club-Foot; Congenital Dislocations; Ectopia Vesicæ; Hare-Lip, &c.

CONGENITAL DISLOCATIONS.—Congenital dislocations are most frequently found at the *Hip-joint.* Cases, however, have been described of similar luxation of the *Humerus*, of the *Patella*, of the *Lower Jaw*, of the *Elbow* (probably only of the radius), of the *Knee*, and of the *Wrist.*

In the last four positions the dislocation is rare. It is usually partial, complete dislocation occurring only with other extreme deformities, the subjects of them being little better than monstrosities. These rare forms may be dismissed in a few words.

A case of congenital dislocation of the *Lower Jaw* on the right side has been described by R. W. Smith of Dublin. The right side of the jaw and right zygoma were smaller than on the left side, the condyle was undeveloped and destitute of cartilage, the coronoid process was small and thin, and the sigmoid notch was barely existent. There were neither glenoid cavity, nor interarticular cartilage, nor capsular ligament. The right superior maxilla and malar bones, and the right side of the sphenoid, were also much smaller than on the left side. In these cases the jaw is abnormally movable, and not fixed as in ordinary dislocation.

Good specimens of congenital dislocation of the *Head of the Radius* backwards exist in the museums of the Royal College of Surgeons of Dublin and of Guy's Hospital. The former was fully described by the late R. Adams. The outer condyle exists, but in front of it there is no rounded head for the radius, nor any trace of the usual convex articular surface ever having existed. The coronoid process and great sigmoid cavity of the ulna are unusually large transversely, and stretch almost the whole way across the lower articular extremity of the humerus, which is entirely formed into one single trochlea wider than natural. The head of the radius, which seems never to have been adequately developed, is situated behind the plane of the outer condyle of the humerus. The tubercle of the radius, directed somewhat backwards, is twice its natural length, and instead of reaching merely to the level of the lesser sigmoid cavity of the ulna, stretches so high up the ulna as to reach nearly to the level of the summit of the olecranon process, while the carpal extremities of the radius and ulna are in their natural state, on an even line with each other. The arm in these cases is in a state of pronation and semiflexion, and there is little or no power of supination. There is a case also recorded by R. W. Smith of dislocation of the radius backwards, with deficiency of the condyle of the humerus, in which there was also on the same side an outward dislocation of the patella, with deficiency of the external condyle of the femur.

Congenital dislocations of the *Knee* are very rare, but a few cases have been described. They generally take the form of partial dislocation of the tibia forwards in one or both limbs.

Very few cases of congenital luxation of the *Wrist*, not in monstrosities, are recorded. There is a case fully described by R. W. Smith, of a female lunatic, æt. thirty-six, who had from birth a luxation of the right carpus forwards and of the left carpus backwards, with the upper end of the left radius small and atrophied. The bones of the forearm in both limbs were only half the ordinary length, and the bones of the carpus were atrophied. A case described by Cruveilhier as traumatic, Smith alleges to have been an example of congenital luxation. There is also a specimen of congenital dislocation of the wrist in the Dupuytren Museum.

Congenital dislocation of the *Patella* is not very uncommon. In nearly all the cases recorded the luxation was in the outward direction, the number of cases in which the displacement was single and symmetrical being about equal. In many of the instances deficiency of the external condyle of the femur fully accounted for the malposition of the patella. In all there was considerable muscular wasting and relaxation of the structures of the joint. In many of the cases the hereditary nature of the condition was remarked.

Congenital dislocation of the *Head of the Humerus*, though less rare than any of the above forms of luxation, does not occur, or at all events is not recognised, so frequently as the similar condition at the hip-joint. There are two varieties, the sub-coracoid and the sub-acromial. Guérin gives two examples of the former, and one of the latter. Both varieties have been fully described by R. W. Smith, who gives four cases of the former, and one of the latter. The leading characteristics of all are wasting of the muscles of the shoulder and arm, an abnormal prominence of the acromion process, and a marked limitation of the movements of the arm. Of the sub-coracoid dislocations, three occurred in males:—1. Æt. 20, the luxation being on the left side. This man had also left talipes equinus. 2. Also a male, æt. 20, the dislocation on the left side. 3. A lunatic woman, æt. 29, with congenital luxation on both sides, the deformity being more marked on the left side. 4. A boy, æt. 9, with luxation on the right side. The only case of congenital sub-acromial or sub-spinous dislocation recorded by Smith was found in a woman æt. 42. She had been a lunatic fifteen years, and was subject to severe epileptic fits, in one of which she died. The brain presented the appearances common in idiots. Each humerus was dislocated upon the dorsum of the scapula, the coracoid process formed a remarkable projection on each side, and the acromion process was unusually prominent, but the glenoid cavity could not be felt beneath it. In fact, an examination showed that there was no trace of a glenoid cavity in the usual position, but there was a well-formed socket, surrounded by a glenoid ligament, upon the outer surface of the neck of the scapula, broader above than below, and reaching upwards close to the under surface of the acromion. The tendon of the biceps, perfect throughout, adhered to the upper and inner part of the circumference. The head of the humerus was oval in form, and atrophied, and occupied the cavity immediately beneath and behind the summit of the acromion.

The third case of sub-coracoid dislocation mentioned above died of meningitis; and examination showed that there was, similarly, no vestige of a glenoid cavity in the normal position; but directly beneath the under surface of the coracoid process, and formed partly upon the costal surface of the scapula and partly upon its axillary margin, there was a well-formed socket about an inch and a-half in diameter. The head of the humerus was close to the under surface of the coracoid process, and only separated from it by the capsule, there being no interval, as there is in the natural condition of the bone, between the upper margin of the abnormal socket and the process just named. Around this socket the glenoid ligament, perfect and well-formed, was continued from the undeveloped glenoid cavity, from the apex of which sprung the tendon of the biceps, in every respect natural. The capsular ligament was perfect throughout. Here, also, the head of the humerus was oval from deficiency of the posterior part of the bone, and there existed, between the greater tubercle and the margin of the head of the bone, where the investing cartilage terminated, a broad, shallow groove corresponding to the elevation which distinguished the normal from the abnormal portion of the glenoid cavity. The shaft of the humerus was small, and seemingly atrophied. Upon the right side, where the deformity was less marked, the deficiency of the glenoid cavity was confined to its inner border, which, to the extent of an inch from above downwards, was entirely wanting, so that the head of the humerus had passed inwards, though not to such an extent as in the opposite joint. The internal boundary of the socket was formed by a ridge of bone, which passed downwards from the under surface of the coracoid process. The oval form of the head of the humerus, and the deficiency of its posterior part, were more striking than on the left side.

It is probable that congenital luxations of the shoulder are less rare than is supposed. They are almost certain to be overlooked during the early years of the patient, and until the bones and muscles have become developed; and then, except in the atrophic cases, so much freedom of motion may have been acquired that this peculiarity is attributed to awkwardness, and the anatomical condition is rarely critically and accurately examined. In those cases where atrophy of the muscles is complete, there ought to be no difficulty in diagnosing this condition from a local paralysis.

Congenital dislocations of the *Head of the Femur* are not rare, although, as Dupuytren pointed out, they frequently escape notice in the infant. Carnochan expresses the opinion that the congenital form of luxation of the head of the femur is of as frequent occurrence as the corresponding dislocation caused by external violence during extra-uterine life.

Dislocation occurs in three directions. The most usual form is luxation upwards and outwards upon the dorsum of the ilium; the second form, directly upwards, is rare; as is also the third form, upwards and forwards, which is usually associated with other very considerable deformities. The great majority of the cases are of the first variety, but the first and second varieties may be taken together, as they are very similar. They occur most frequently on both sides and in girls. Dupuytren, who saw 26 cases, found 22 in females and only 4 in males. In all but four of the cases the dislocation was double. Of Brodhurst's 36 cases, 28 were females and 8 were boys; 29 were double luxations, and 7 were single. Of Cruveilhier's 7 cases, 5 were double and 2 single. In 7 cases seen by the writer, 6 were double and 1 single, and all were in girls. Four of these symmetrical cases were shown together, on November 17, 1883, at a meeting of the Royal Medical and Chirurgical Society.

The signs of this dislocation are not distinctly marked at birth, and, unless they are sought for, are easily overlooked. When the child has acquired the power of walking they become unmistakable. They are best seen in the erect position, for when the patient is lying horizontally on the back many of the peculiar symptoms disappear. The main characteristics of symmetrical congenital dislocation of the hip-joint are —an abnormal prominence of the great trochanters, which are situated higher and generally more backward than usual. There is a wide, flattened appearance of the nates; a marked compensatory lordosis, and accompanying prominence of the belly; a more or less wasted condition of the muscles of the hip and thigh; and a peculiar, swaying, waddling gait, the width of the hips being increased, the knees more nearly approximated, and the usual movements of the hip-joints being somewhat limited and awkward; the legs, also, are small, and the feet weak, with a tendency to *flat-foot.* When the dislocation is on one side only, the gait is, of course, different, and less characteristic, the shortening of one limb causing more marked lameness.

The increased mobility of the head of the dislocated thigh-bone is very remarkable, but is well accounted for by the relaxed condition of the ligaments of the joint. The anatomical conformation of the bones of the part varies somewhat according to the age at which the examination is made. Before the age of attempting to walk, the head of the femur will not be found to have travelled far, but only to occupy the posterior and superior border of the shallow acetabulum where its fibrous margin is deficient. But a few years later the somewhat flattened head of the femur will be found upon the dorsum of the ilium in a direction backwards and upwards, the acetabulum being shallow, and sometimes of a more or less triangular shape, and filled with adipose tissue. The ligamentum teres is elongated and attenuated, and the capsular ligament presents an hour-glass appearance, being large at its attachment to the margin of the acetabulum and to the head of the femur, but very narrow at its middle, where it surrounds only the ligamentum teres and is greatly stretched. In a few cases that have been described, the round ligament has been said to have been absent, and it is probable that in these cases it has gradually become so attenuated as to have given way.

In the cases where the dislocation is more directly upwards, the gait is slightly less characteristic, and the lordosis and prominence of the abdomen are less marked, but the anatomical condition is very similar.

There is no agreement amongst the writers on this form of dislocation as to its pathology. Amongst the different causes and explanations which have been given of the occurrence of congenital dislocations, the following may be enumerated :—1. External violence affecting the fœtus in utero ; 2. The position of the fœtus in utero, and violence during parturition (Cruveilhier) ; 3. Morbus coxæ in utero ; 4. A distension of the capsular ligament, and a consequent disproportion between the head of the bone and its socket (Stromeyer) ; 5. A primitive alteration in the germ, or an aberration of the formative power (Dupuytren) ; 6. A primitive alteration in the nervous centres ; 7. An arrest of development in the acetabulum ; 8. An arrest of development of the head of the femur ; 9. An active or primary retraction of the muscles (Guérin) ; and 10. Paresis of the muscles.

The first cause mentioned may be dismissed as unsupported by evidence. In support of the second it has been asserted that in the majority of these cases either the breech has presented at the time of birth, or they have been first children, or born after difficult or tedious labours. It is difficult to ascertain if there is really any foundation for these assertions. The birth-presentation is not recorded in the majority of the cases which have been collected. In the writer's seven cases, only one was a breech presentation; one other was a first child; but with the rest the labours were easy and not prolonged. Adams, too, reported that in the majority of his cases, 50 in number, the labours were free from difficulty. If luxations did occur from this cause, it would be more accurate to describe them as traumatic dislocations occurring at birth than as strictly congenital luxations. It may be further added, that it has been sought to explain the more frequent occurrence of this dislocation in females, by pointing to the greater width of the female pelvis, as being more likely to be the subject of compression and consequent displacement of the femora during birth by the breech. As a physiological fact, however, the pelvis of the female at birth is smaller than that of the male, and the supposition is incorrect. Nos. 3 and 4 have been given as causes in a few cases, on good authority. The great majority of the cases, however, are due to one or more of the remaining causes, Nos. 5 to 10, which may all be classed under the one term of *arrest of development* or *faults of formation.* This arrest of development, whilst it is more marked in the acetabulum than in the other parts entering into the formation of the joint, is, in all probability, primarily due to some deficiency or derangement of the nervous centres. And this is probably the case in all the forms of congenital dislocation, and is especially evident in the more unusual forms which have been shown above to be generally associated with idiocy or lunacy. In some of these cases the malformation has undoubtedly been hereditary.

The absence of the ligamentum teres in a few of the hip cases has led to the suggestion that such absence may possibly be a reversion to the structures of the hip-joint in fishes and reptiles, where it is absent, as it is also in the kangaroo, the elephant, the rhinoceros, the hippopotamus, and in the phocidæ, sloths, and orangs.

During the growth and development of the subjects of these dislocations, considerable changes take place in the bony framework of the pelvis and the surrounding parts. The innominate bones are found to be smaller and more vertical in position. According to Carnochan 'the anterior inferior spinous processes of the ilia are found to be more prominent, and the depressions existing below them are seen to be deeply grooved by the continued traction of the tendons which played in them during life.' The greater the amount of displacement of the head of the femur, the more the shape of the pelvis is altered ; but in all the cases the antero-posterior diameter is diminished, whilst the transverse diameter is proportionately increased. The sacrum is usually somewhat stunted in growth. When the dislocation is on one side only, the pelvis becomes gradually somewhat twisted, and the ilium of the affected side occupies a slightly higher level than on the sound side, the symphysis pubis being drawn a little towards the same side. Wherever congenital dislocation exists, the bones are thinner than usual and somewhat atrophied. Any imperfect acetabulum that may have existed becomes filled up with adipose tissue and the margin, if any, becomes flattened

In many cases a shallow depression is formed in the new position of the head of the femur, and this depression usually becomes sooner or later surrounded by a deposit of new bone. At the same time the head of the femur may become smaller and more rounded.

Treatment.—Much difference of opinion has existed as to the possibility of surgically correcting the displacement in these cases. Dupuytren denied it. But since his day several cases of successful reduction have been reported, and it is probable that there are some cases in which an attempt at rectification should be made. There are two conditions of success:—The luxation must be recognised in early life, and before the relative condition of the parts has been altered by the natural adjustment which gradually takes place; and, secondly, the departure from the normal conformation of the articular surfaces must be moderate and much less than exists in many of the cases. If nothing is done, the tendency is to increased deformity, the amount of displacement being augmented by the weight of the body in the erect position. Where such increased displacement has taken place, and where the changes in the bones above described have been accomplished, no readjustment is possible. But in an earlier stage, and where the displacement is not excessive, some attempt at reduction should be made. To effect this, when ordinary manipulation is insufficient, Guérin has suggested the subcutaneous division of tendons which seem to maintain the deformity, and also some subcutaneous scarifications in the vicinity of the acetabulum, in order to promote the deposit of organising material. Cases of success at twelve and fifteen years of age have been recorded; but it is only in early years that we may count upon success, and then only in the less marked cases. Apparatus is required to maintain the bones in proper position. The horizontal position of the patient must be maintained, and after the first few weeks passive motion must be daily used. A few months later an apparatus is necessary, to enable the patient to move and exercise the limbs whilst still remaining in the horizontal position, the joint being, of course, unable to bear the weight of the body until the parts have had time to be consolidated in their new position. This motion and exercise must be persevered in for many months before permitting exercise in the erect position, the head of the femur being throughout retained in position by a firmly and properly adjusted bandage. The general treatment of the patient must not be neglected. A webbing support and strap will be required as a permanent means of support, and this will be found of some service in the great majority of cases in which no other treatment is advisable.

George Cowell.

CONGENITAL FRACTURES. *See* Intra-uterine Fractures.

CONGENITAL HERNIA. *See* Hernia, Inguinal.

CONGENITAL SYPHILIS.—The terms ‘congenital,’ ‘transmitted,’ and ‘hereditary’ may, so far as syphilis is concerned, be considered synonymous. They all stand in contradistinction with ‘acquired,’ and imply that the disease was obtained from a parent before birth, and not from post-natal infection. In all cases of acquired syphilis, with the exception perhaps of a woman pregnant with a tainted fœtus, a primary sore, or chancre, is of necessity the first stage of the disease. In inheritance no such sore occurs, but the virus passes directly from the fluids of the parent into those of the child. The term ‘congenital’ must not be held to imply that the inheritance is obvious at the time of birth, for it may easily be the fact that no signs of it become apparent until long after. Not the less is it true that the taint—or rather the living virus—was existent in the child at birth.

There may be some variety as to the precise details of inheritance. It may be that it is from the father alone, or from the mother alone, the poison being in each instance present in the parent at the time of conception. To these modes we may give the name ‘conception inheritance,’ qualified as ‘paternal’ or ‘maternal,’ or ‘sperm and germ inheritance’ respectively. This is the only kind of direct inheritance which, so far as the father is concerned, is possible. The mother may, however, be the means of communicating the disease to her offspring in another manner. It may have been the fact that at the date of impregnation she was perfectly free, and that she acquired the disease at some period of her pregnancy. In this case the fœtus will receive the poison, not at the very starting-point of life, but after a period, of variable length, of healthy intra-uterine life. Facts in abundance prove that at whatever period of pregnancy a woman acquires syphilis, if only time be allowed for her development of the disease, there is great probability that it will pass to the fœtus also. Nor does this happen in the case of syphilis only. If a pregnant woman suffers from smallpox, her fœtus will also be affected, and very probably it would prove to be the same with the other exanthemata if their stages were sufficiently prolonged.

It may be convenient here to ask the question whether the transmission of syphilis in this way from the mother's blood to that of her child, through the placental circulation, produces results differing from those which follow sperm—or germ—inheritance. The question may be answered, temporarily at any rate, with a denial, and the *onus probandi* may be suitably thrown on those who assert it. The writer attended a lady in the seventh month of her pregnancy for primary syphilis. He saw her indurated chancre and also her rash. Her husband was also under his care for the disease. The child was born looking healthy, but it began, as usual, to suffer from snuffles at a month old, and it went through a severe infantile illness with all the usual symptoms. It recovered under mercurial treatment, but subsequently showed characteristic teeth and physiognomy, and had a severe attack of keratitis with periostitis of the tibia and effusion into knee-joints. This child was under observation for ten years, and there was nothing whatever to distinguish its symptoms from those which we see so frequently as the result of sperm—or germ—inheritance. Other cases of a similar kind might be adduced, and they justify us in holding for the present that the results of pregnancy-infection and conception-infection may be, and probably are usually, closely similar.

We must next ask whether sperm inheritance differs in its results from germ inheritance, and whether when the child receives a taint from both parents it suffers more severely or in any way differently from when it receives it from only one. We enter here upon a most difficult enquiry, and our knowledge of the laws of inheritance are not sufficiently advanced to permit of categorical answers being given. Nor, indeed, have our facts, as to the inheritance of syphilis, been as yet collected and compared with sufficient care. It may prove that future investigations will succeed in establishing more detailed and definite laws, as explanatory of the variety of clinical phenomena which we witness. On the other hand, it may perhaps come about that we shall see that we have already gone farther in this direction than either our present or our future knowledge will warrant. We are met at the very threshold of our enquiry by the fact, that we do not yet know the limits of possible variability in the phenomena of syphilis, independently of any appreciable change in the conditions of its origin. Thus we are constantly in danger of assuming that differences which we observe in the course and severity of the disease are due to peculiarities in the mode of acquisition, when in reality they were quite possible under modes which were identical. The more we study the subject, the more shall we feel obliged to acknowledge the importance and width of bearing of this fallacy. We must also be exceedingly careful as to giving our confidence to single and isolated narratives, whether they be the results of our own observation or the records of other surgeons. There are in respect to syphilis such endless sources of mistake that, however clear the seeming inference may be, it is never safe to trust it unless it has the support of many independent observations. Acting on this rule as to the reception of evidence, the writer will in what is to follow, trust far more to the general indications of daily experience than to the apparent lessons of individual but isolated cases.

Whilst all admit that a child may inherit syphilis from its mother, there are possibly still some who doubt whether it can inherit from its father independently of the mother. The evidence on this point seems to the writer overwhelming. It is a matter of constant experience that the father of a syphilitic infant is known to have had the disease before marriage, whilst not a symptom has ever been observed in his wife. It is improbable in the highest degree that a large number of married women should acquire syphilis in its primary form, pass through its secondary stages, and yet never know it. Yet this is the supposition which we must adopt, not once or twice, but as an every-day hypothesis, if we reject the belief that a syphilitic father may beget a syphilitic child quite independently of any previous infection of its mother. There are, however, other supporting facts. In these cases it very frequently happens that the taint in the father is wholly latent, and that he has for long appeared to be absolutely well, and that he has no trace whatever of sore on his penis by which a primary infection might be effected. Then, again, not only has the disease wholly escaped the observation of the mother, but she appears, on the most minute examination, to be wholly free from symptoms, and in many instances she remains so in after-life. Such facts are wholly inconsistent with the supposition that she has passed through syphilis in its ordinary stages as an acquired disease.

In nine cases out of ten, acquired syphilis is an affair which its victim cannot either ignore or forget.

It being then taken as established that a child may at the time of conception inherit syphilis from its father alone, from its mother alone, or from both simultaneously, and that it may take it from the mother's blood during pregnancy, we have to ask whether the disease presents any differences under these several conditions. The answer to this has already in part been given, for it has been asserted that what has been termed 'pregnancy inheritance' is just as severe as conception inheritance. Diday has cited a number of facts in proof of this, and all that the writer has observed is in unison with his conclusions. To avoid tediousness, it may perhaps be asserted briefly that there is no reason for believing that the inheritance from the mother (germ-transmission) produces more serious results than sperm-transmission, or that the child who inherits from both parents suffers more severely than he would if one were free. In connection with this assertion it is to be freely admitted that there are certain facts for which as yet we can find no explanation, and which may possibly lead to some modification of this rule. The cases exceptional to rule are here referred to, in which children are born with syphilitic lesions actually present or with traces of intra-uterine disease, and to the fact, apparently established, that the two sexes do not suffer exactly in the same ratio, the examples of infantile iritis, of keratitis in adolescent periods, and of syphilitic deafness being much more common in girls than in boys.

Having just asserted that the several modes of inheritance amount as regards the heir to exactly the same thing, we have next to ask whether the stage which the disease has reached in a parent makes any difference as to that manifested in the offspring. This is best answered by saying broadly that there is no evidence in proof that it does so. Some facts which are unexplained undoubtedly exist, but there is enough of positive evidence in proof that children which present precisely similar phenomena may be born at the most various periods of the parental disease to make us put them for the present aside. Diday and others have collected evidence on this subject. We shall probably be quite safe in making a *tabula rasa* as regards all theories hitherto advanced in explanation of the different degrees of severity which inherited syphilis displays. These differences are probably not greater than those which we observe in the case of the acquired disease. Chancre-syphilis, as is well known, falls with very different severity of incidence on different individuals. The reasons why it does so are inexplicable, just as are those which apply to the parallel phenomena in smallpox and scarlet fever. It will be wise, therefore, to clear away the old hypotheses and begin the investigation of facts anew.

With the hypotheses which we thus put aside it may be well to associate a piece of matter-of-fact observation which is probably a mistake. It is generally said and accepted that the inheritance of syphilis, when continued through a family of children, shows a tendency to fall off, and decreases in severity in each successive child until it comes finally to an end. The writer himself must take some share of responsibility for the perpetuation of this opinion, which he now believes to be an error. It is also strongly stated by Diday. That the eldest child or elder children—those born nearest to the parental acquisition—are the most likely to inherit it, is unquestionable, and so also is the fact that the younger ones often escape. In admitting this, however, we by no means deny that the disease is apt to occur in a modified form in the younger ones. We shall probably be nearer the truth if we assert that the inheritance of a syphilitic taint is often irregular, that frequently, of several children born under apparently similar conditions, one may receive it and another escape; but that, if it be received, it is always one and the same specific malady. Although it may and does develop with very differing degrees of severity, yet the child who inherits it at all inherits its full risks, and is just as liable as another to its severest manifestations. Much evidence might be adduced to show that, when a succession of children suffer, the youngest may suffer as severely as the eldest. It might also easily be proved that under such circumstances the disease may skip one child and appear again in one still younger.

All authorities are agreed that, as a rule, parents who have reached the tertiary stage, although themselves still liable to suffer, do not transmit. Now and then transmission under such circumstances does occur, especially in the case of the mother, but the rule is as here stated. It may be expressed in another manner—namely, to the effect that those who have allowed a long period to elapse—say two or more years—are not, as a rule, capable of transmitting. The body of evidence on this point in the case of fathers is very large indeed. We see every day fathers of families, none of whose children have ever shown a symptom, but who are yet themselves—after, it may be, long periods of latency—destined to suffer from tertiary phenomena. Such facts are far less frequently seen in the case of women; but then we must remember that the proportion of mothers who have in former life suffered from syphilis is far smaller than that of fathers. Making, however, all allowance for this, we may still believe with confidence that a child has much less chance of escape if the mother be diseased than if the disease be confined to the father. In the latter case, sperm-transmission is the only mode of conveyance possible; whilst in the case of the mother, should the poison not be conveyed with the germ at the time of conception, there are yet nine months of risk to be run, during which it may pass from the blood.

The expressions just used will suggest the hypothesis which is perhaps the best for our use in the attempt to unravel the intricate phenomena of syphilis. It is that the transmission of the disease, as well in inheritance as in acquisition, is always effected by the conveyance from person to person, not of a tendency to disease, but of a particular virus. This virus is probably as specific and individual as are the seeds of barley or clover. If it passes into the sperm or germ, then the fœtus is liable to the full development of the disease; and if it chance that none of its elements do pass, then the offspring, although born to a tainted parent, escapes free. This virus is, during the early periods of syphilis, existent in great vigour in the parental fluids, and during these transmission is almost certain. It diminishes in power, or probably in quantity, as time passes on—and hence the greater chance of escape of younger children—until finally it wholly disappears or dies out. Its disappearance is, however, by no means coincident with entire restoration to health of the patient, who, although fortunately impotent to transmit, is, as just stated, still liable to suffer.

Before proceeding to sketch the results to the child of inherited taint, it is necessary to advert to the curious and unexpected fact that a woman who bears a syphilitic fœtus inheriting from its father—although herself remaining free from symptoms—acquires silently a state of constitution which protects her from syphilis in the future. No other interpretation can, the writer thinks, be given to the facts, upon which is based what is known as Colles' law. The child born of such a mother, if suckled by a wet nurse who has recently had syphilis, will not cause any fresh disease, but if by a woman hitherto free from taint, the risk is great that a nipple-chancre will result. Now the mother of the child, although, so far as appearances have gone, free from syphilis, is, as regards fresh contagion from her child, wholly free from risk. She has thus in some way gained the position of one who has suffered from acquired disease. We know nothing as to the relation which such a protected mother would assume towards other children which she might bear. It is obviously possible that if, in a second marriage, she should bear a child to a healthy father, such child might inherit from her, but it is by no means certain. It is also possible that, in continuing to bear children to a first husband, her taint, acquired through the fœtus, may act in reference to later conceptions, and may thus prolong the risk to their family after the father has ceased to transmit.

The evolution of hereditary syphilis.—The usual course, when syphilis is inherited, is for the fœtus to remain quite healthy during its intra-uterine life. At the time of birth it almost invariably has a clear skin, and appears to be in perfect health. At the end of three weeks or a month, symptoms of coryza, as shown by what is named 'snuffles,' usually begin, and are quickly followed by some eruption on the skin, attended by wasting and fretfulness. During the second, third, and fourth months, unless cured by treatment, all the symptoms will be at their height. Excepting in the addition of 'snuffles,' these secondary symptoms are much the same as those observed in the acquired disease. The precise type of the skin-eruption may vary in the same way—may be papular, scaly, pustular, or bullous. Polymorphism is noticed, and most of the other less frequent phenomena of constitutional syphilis in its early stage, such as loss of hair, iritis, condylomata, and rheumatoid pains are apt to occur. All these secondary symptoms are symmetrical in arrangement and transitory in duration, just as they are in the acquired disease. If the child survive, whether treated or not, by the end of a year all the symptoms will probably have disappeared. The influence of mercury as a specific is just as definite as in the acquired disease. All the symptoms, as if under the influence of a spell, vanish when it is used. Certain peculiarities are stamped upon all the symptoms, however, which are probably due to the very tender age of the patient and incomplete development of the tissues. Thus the general health suffers much more than in the acquired form, and death—an event almost unknown in the latter—is a not infrequent consequence. Periostitis of a definite character occurs in connection with the rheumatoid pains, and, in the case of the epiphyses of long bones, may result in abscess, whilst in the case of the skull-bones it often causes simultaneous thinning and deposit of new bone.

In consequence of the fatness of young infants, the eruptions are prone to assume the form of intertrigo; and, owing to the irritation of the buttocks, &c., by urine and fæces, all syphilitic eruptions are very prone to affect those parts severely. The diagnostic recognition of secondary syphilis in infants is usually easy, but in a certain proportion of cases it may call for the utmost care and skill in observation. The character of the eruption, its colour—like the lean of ham—its location and symmetry of arrangement, its coincidence with snuffles, wasting, and withered aspect generally, make up a picture which it is often impossible to mistake. The very widest allowance for variations in severity must, however, be permitted, and common eczema and other infantile eruptions often closely simulate those of syphilis. It is not uncommon for the *rôle* to be exceedingly imperfect; thus there may be snuffles and mucous patches only, the general rash being quite omitted, or there may be no snuffles and the rash may be ill-marked. Instead of the 'old-mannish aspect' which is constantly mentioned, the child may continue throughout in apparently excellent health. Lastly, it is certain that an infant may pass through the secondary stage of inherited syphilis without ever presenting any symptoms which attract the attention of its nurse. Such cases are common, and they have their exact parallels in the case of the acquired disease. Those who have shown no symptoms in infancy may yet suffer in later life. It is clearly to be understood, however, that when this happens to adolescents they suffer from a class of symptoms wholly different from those of infancy. It is not that the secondary stage has been delayed, but simply that it has been passed through without ostensible disturbance. If secondary symptoms of the kind described are to occur at all, they will show themselves in infancy, and in a vast majority of cases within the first three months of life. This is a very important fact. Many syphilitic infants perish during the outbreak of the secondary stage, and were it not for the specific influence of mercury, probably many more would do so.

If, however, the child survive, in the course of from six months to a year the symptoms common to this stage—the rash, snuffles, mucous patches, &c.—will wholly disappear, and there will follow a period of some years during which no active symptoms occur. After this period of latency there will in many cases come a group of very peculiar affections. Amongst these we must mention chiefly inflammations of certain parts of the sense-organs, the eye and ear. The affection of the ear is attended by noises, &c., but usually neither by otorrhœa nor by pain. It affects both ears, and may induce almost total deafness in the course of two months. Many cases in the early stage recover, but if once the deafness is complete it appears to be incurable. This affection rarely occurs before puberty, and may be delayed till the twentieth year. About the same period of life, but with wider limits still, since it may occur yet earlier or much later, there is a remarkable liability to a very peculiar inflammation of the cornea. Interstitial keratitis in a typical form is always a consequence of syphilis, and it is sufficient for the diagnosis. It must, however, be carefully diagnosed. It usually begins by cloudiness of the substance of the cornea, with ciliary congestion and irritability. The clouds increase and coalesce until the whole cornea looks like ground glass. The affection begins in one eye, but, in the course of a few weeks, attacks the other also. It is always, in the end, symmetrical, although in rare cases the interval between the two eyes may extend to several years. When at its height, interstitial keratitis may for a few weeks almost entirely abolish sight; but one of the most remarkable features in its clinical history is its invariable tendency to recovery. In the end the cornea usually clears completely. *See* CORNEA, Inflammation of the.

At the same time as the keratitis, the patient often suffers from chronic synovitis of one or more of the large joints. The knees are most frequently affected, and there may be free effusion lasting for some weeks, but not often attended by much pain. Almost invariably the effusion disappears, and the joint is perfectly restored. These joint-affections may occur either before or after the keratitis, and sometimes in those who never suffer from the latter.

Periosteal affections of the long bones are at this stage not uncommon, and sometimes very severe. They may occur in any part of the skeleton, and often produce numerous and large nodes. If near to joints, these nodes may produce much crippling of movement. If situate on the shaft, they may produce an appearance of curving, which, in former times, used to be mistaken for rickets. Overgrowth of the bone in length, as well as thickness, is an almost constant result of this form of periostitis, since it often persists for years. This overgrowth, if one tibia only be affected, may produce an increase of length in relation to the other of an inch or inch and a half, and constitutes, with the bending, one form of the malady known as osteitis deformans. Sometimes almost all the long bones in the body are simultaneously affected by these ossifying nodes. The skull, however, at this stage of the malady, but rarely suffers. Occasionally suppuration attends the periostitis, and a surface of diseased bone, roughened and much thickened, is exposed. The condition produced may usually be diagnosed from other forms of suppurative periostitis with necrosis, by the circumstance that the exposed bone is not enclosed by any shell of new bone, that it is extremely slow to separate, often remaining visible, but firmly fixed, for a year or more. The periosteum and cellular tissue overlying it are usually destroyed.

At the stage of the disease of which we are speaking, nothing is less common than for any special affection of the skin to occur. The only eruption which can happen is a form of rapidly destructive lupus. No scaly or papular eruptions, and nothing in the least resembling common lupus, or the serpiginous ulceration so common in the acquired disease, are—with the very rarest exceptions—observed. Nor are any forms of disease of mucous surfaces of the tongue or the palate at all frequently seen. It may be asserted also that affections of the viscera are very exceptional, and diseases of the nervous system scarcely less so. A few cases of ophthalmoplegia, and a few of epilepsy, apparently in connexion with inherited taint, are on record, and a few also in which the grey matter of the hemispheres appeared to suffer, and a state approaching idiotcy was the result; but all observers agree that they are very infrequent.

The subject of such taint having passed through the attack of keratitis, attended, it may be, by periostitis or loss of hearing, usually afterwards regains fair health, and continues through the rest of his life free from symptoms. No diseases likely to shorten life have been associated with the diathesis; above all we may assert that there is no special proneness to diseases of the scrofulous or tuberculous class. Year by year usually the physiognomical and other characters of the diathesis become less and less obvious, and in advanced life it may be very difficult to recognise it.

No trustworthy evidence in support of the suspicion that the subjects of inherited taint can in turn transmit it to their children at present exists. Most of the facts recorded have been published by the writer. It is perfectly certain that those who have themselves suffered very severely may become the parents of children who appear to be in every respect healthy. There is neither evidence nor probability in support of the conjecture that syphilis is, in the third or fourth generation, the cause of any chronic diseases of the skin or of scrofula.

Such being the general picture of the course and final results of inherited syphilis, it remains to notice certain facts which are more or less exceptional to what has been said. Although it is true that for the most part the taint does not appear to affect the infant until some time after it has commenced independent existence, yet there are numerous instances in which it causes intra-uterine death. Thus, abortions and miscarriages at various periods of pregnancy are common in syphilitic mothers. It is quite possible, however, that the influence of syphilis in this direction has been exaggerated. It is also possible that the cause of what happens to the fœtus is, in such cases, due rather to disease of the mother, and perhaps of the placenta, than to the breeding of the syphilitic virus in the fluids of the fœtus itself. If this be not so, it is exceedingly difficult to explain why the majority of syphilitic infants should be born plump and well-nourished, and remain for a month or so without symptoms, whilst others, on the contrary, perish at, it may be, an early period of intra-uterine life. Enough of pathological evidence has, however, been recorded to compel us to admit that the fœtus may itself suffer from syphilis, and may exhibit lesions of the viscera, bones, or skin which conclusively denote it. Such lesions are, however, rare. It is a most noteworthy fact that, if syphilis affects the fœtus it almost invariably causes its death, for nothing is less common than for an infant to be born alive with extant signs of taint. Three weeks or a month almost invariably intervene before the eruption, snuffles, &c., appear. A very perplexing exception to this occurs in the case of what is known as infantile pemphigus. In this disease the eruption may appear, in an apparently healthy child, within a day or two of birth, and the case may end in death within a week. These cases need further investigation, and it is hopeless, in our present state of knowledge, to attempt to explain them.

Diagnosis.—It will be convenient to treat of diagnosis under different heads according to the age attained by the infected child.

1. *In the fœtus and at the time of birth.*—It is probably far too hastily assumed that if a dead fœtus presents a peeling skin, and is shrivelled, it has probably died from syphilis. Such conditions are common whenever death has occurred long before expulsion. So also, as has been already hinted, is the belief that miscarriages imply syphilis held probably far more widely than facts warrant. Miscarriages are common from many other causes, and, conversely, it is quite certain that many mothers, suffering severely from syphilis, carry their infants easily to full term, and produce them in a viable condition. The recognition of syphilis in a dead and possibly decomposing fœtus is a matter of great difficulty and uncertainty. As to the existence of signs of syphilis in living infants born at full time, we must receive the published testimony of the older surgeons with caution. Not having the importance of this special point in mind, they often assumed, on seeing a syphilitic infant, that it had been born with the symptoms. Obstetricians would probably give evidence of a different kind. Thus, whilst Diday, who had enjoyed very extensive opportunities of special observation, had never seen signs of syphilis present at birth, we find Sir Astley Cooper stating that he had seen several children born with copper-coloured eruptions on the palms, soles, and buttocks. Probably all that he meant is that the infants were young when seen. The writer has never himself seen an infant born with a syphilitic eruption, or one in whom the evidence was clear that such an eruption was present at birth. In spite, however, of some scepticism, the facts must be accepted that such infants are occasionally seen. Rondelet, Doublet, Gilbert, Guérard, and Landmann are all quoted by Diday as having published single cases in which infants were born with characteristic eruptions. Visceral disease, as of the liver, spleen, thymus gland, &c., has also been encountered under conditions implying that the poison had been actively at work in the fœtal organism during intra-uterine life.

2. *During Early Infancy.*—In many cases the recognition of inherited syphilis at the age of six weeks or two months is exceedingly easy. The stuffed and expanded nose, the snuffles, the pallor, the patches of peeling erythema about the face, neck, and nates, constitute a picture which can scarcely be mistaken; but which is yet often heightened by such symptoms as sores at the angles of the mouth and anus, a peculiar odour, and periosteal tenderness of various bones. In many cases, however, one or several of these symptoms may be omitted or ill-marked, and in some they are all of them so. In certain instances, therefore, it is to be admitted that the diagnosis may become very difficult or even impossible. In such cases help must be sought from the parents' history, and from facts, if there are any, as to previous births. In doubtful cases each one of the symptoms must be scrutinised with suspicion. Infants often have a certain kind of snuffles who are not syphilitic, and common eczema of the nates may assume exactly the same tint as that which is specific. Sores, in connexion with diarrhœa, may occur at the anus, which may be mistaken for condylomata. It is seldom safe to trust to any one symptom unless it is very well characterised. A typical condyloma is conclusive, and so also of certain types of skin-eruption, and certain forms of bone-disease.

For a knowledge of the conditions of periostitis which denote syphilis in the infant, we are indebted to very recent observations. When M. Diday, in 1856, wrote his work on this disease, he stated that the records of medicine comprised scarcely any instances of bone-disease in connexion with inherited taint. At the date of the writer's own work, 1863, he had recognised the frequency of nodes in later periods of life, and the occasional occurrence of periostitis in infants. It was reserved, however, for Dr. Taylor, of New York, Dr. Wagner, of Berlin, and Professor Parrot, of Paris, to show that bone-lesions were really very frequent at early periods. They had been overlooked because they were usually—like the other phenomena of this stage—transitory, and because they but rarely led to suppuration. The careful investigation in this country by Drs. Barlow and Lees of the opinions expressed by Professor Parrot, have confirmed the correctness of these in the main, whilst they have corrected certain errors of inference. *See* CRANIOTABES. The chief difficulty consists in the similarity which some of the infantile bone-lesions of syphilis present to those of rickets. As a rule, however, the syphilitic lesions occur at an earlier age, are attended by more definite signs of inflammation, and are not accompanied by the other phenomena of rickets, such as profuse sweating of the head, and buttons on the costal cartilages. Congenital syphilis and rickets very often co-exist; but there is no reason for believing that the one is in any sense the cause of the other. For purposes of diagnosis it may be sufficient to state that, in infants suffering from syphilis, it is very common to find certain areas in the skull tender and slightly swollen, and the regions of the epiphyses of long bones often suffer in a like manner. These lesions are often multiple, and may make all movements of the limbs so painful that paralysis may be suspected. Careful examination will always detect tender swellings of periosteum near to the junctions of the epiphyses, and sometimes on the shafts. These swellings are often of considerable size, much larger and, at the same time, more inflamed than those of rickets. Suppuration is not common, but it does occasionally occur. If this form of multiple periostitis is seen within six months of birth, it is almost certainly due to syphilis.

The state of nutrition is no safe guide in cases of doubtful diagnosis. In those which are self-evident it is often very characteristic. The infant is puny, emaciated, and shrivelled, and has features which resemble those of an old man. It is not uncommon, however, for syphilitic infants to remain throughout plump and healthy-looking. In doubtful cases reference may be made to the state of the palms and soles, which often show peeling patches, and to that of the nails, which sometimes become malformed and look as if they had been pinched laterally.

3. *At periods of life subsequent to infancy.*—After the infantile phenomena have passed away—roughly speaking after the end of the first year—the recognition of the subjects of inherited syphilis will depend—1st, upon certain structural peculiarities which have been left as the results of the secondary lesions; and 2nd, upon the occurrence of new local inflammations which are characteristic of the disease. To take the latter first, it may be broadly stated that if a child or young person, without either ear-ache or otorrhœa, becomes quickly and completely deaf, it is almost certainly syphilitic. In like manner the same diagnosis becomes almost certain if it shows well-characterised and symmetrical interstitial keratitis, or erosive lupus, or ulceration of the palate. Respecting each of these lesions, the exceptions to the statement that they are due to inherited taint are very few indeed. Such is also the clinical fact respecting multiple chronic nodes of long bones, and disseminate choroiditis.

Under the head of marks left by secondary lesions, we have to describe the hereditary syphilitic physiognomy, the peculiar features of which were first characterised by the writer, although he was not fortunate enough to assign all correctly to their true causes. This physiognomy consists, in the first place, of a peculiarly square forehead, with prominent frontal eminences and shallow furrows beneath them; a flattened and wide bridge of nose; a pale, soft, muddy skin, with little scars or pits in it; and radiating scars about the mouth, especially at the angles. To these we must add —as of yet higher value than any or even all of them—that the upper central incisor teeth, of the permanent set, usually show a single vertical notch, and are dwarfed in all their dimensions, but especially as to width. Other malformations of the teeth, and especially of the other teeth, are usually present also, but are indicative rather of the specific treatment which the child has required in early infancy than directly of syphilis. Hence it follows that in other cases than syphilis, if for any reason mercury has been much given, similar malformations may be present. Under this head reference is made to defects in enamel, to horizontal markings, to warty growths on the free edge, and to what are known as honeycombed teeth. The upper central incisors are the only teeth upon the malformations of which reliance can be placed. When their notches are well-marked the condition is, the writer believes, quite pathognomonic. Great caution must, however, be exercised in appreciating their peculiarities.

In many patients the physiognomy of hereditary syphilis is rendered more easy of recognition by the fact that the patient has already passed through an attack of keratitis. Such attacks often leave, for long periods, a certain slight degree of haze of the corneal structure and a peculiar steel-grey tint of the iris, which very much assist the diagnosis. If the recognition is difficult the ophthalmoscope should be used, and the periphery of the fundus carefully explored. If conditions resembling either disseminate choroiditis or pigmented retinitis are discovered, the diagnosis of syphilis is made highly probable.

Treatment.—The principles of treatment of inherited syphilis may be very briefly expressed. Mercury should be given, cautiously but efficiently, in all stages of the disease. If the patient be feeble and cachectic there is the more need for the remedy, though of course the greater must be the care taken that it does not disagree. The infant must be judiciously and liberally fed during the course. As a rule iodide of potassium is both more depressing and far less efficient than mercury, and should be avoided. It must be admitted, however, that we have, in the risk of damage to the teeth, a reason against the use of mercury. This risk is so considerable that, in cases in which the symptoms are but slight, and the child's health not suffering, it may be right either to avoid specifics, or to use only the iodide. This remark applies only to infancy, whilst the permanent teeth are as yet uncalcified. In all the later periods there is no objection to mercury. Especially ought mercury to be speedily pushed if deafness is threatened. It is quite true that it does not arrest the progress of the lesions due to inherited taint in the same definite and speedy manner in which it subdues those of the acquired disease. Notwithstanding this admission, the writer is sure that its use is generally very advantageous, and that we usually err in not giving it sufficient confidence. Inunction is the safest plan, especially in infants, but it may be given internally, in the form either of grey powder or the solution of bichloride. The dose must vary with the age and strength of the child. It is well to begin with very small doses, and to increase until definite effects are produced, either of disorder to health or disappearance of symptoms. The oleate of mercury, 10 or 15 per cent., is very convenient for inunction, and less likely to excite suspicion than the ointment. If given by the mouth, small doses frequently repeated are much to be preferred to large ones.

It goes without the need of saying that the utmost attention is to be given to the general health of the syphilitic infant. As a rule the mother should be the nurse, and her diet should be liberal and carefully regulated. If the mother cannot nurse, then artificial food, cow's milk, or still better, that of asses, must be given. On no account, under no circumstances, and with no precautions, must a healthy wet nurse be allowed to take a syphilitic infant. The risk of nipple infection is far too great. In this respect the child's own mother is in no danger.

The attempt to treat the child through the mother's milk by administering to her either mercury or the iodide, is a roundabout and inefficient plan. It is sometimes resorted to in cases of extreme debility on the part of the infant, but even in these it is probably more likely to disagree and less likely to cure than a mild inunction would be.

The treatment of the fœtus in utero is often carried out by means of the administration of mercury to the mother, and probably with success. If a woman who is known to have had syphilis within two years become pregnant, she ought, for the sake of her child, to take mercury during most of her pregnancy. For this purpose the grey powder in doses of a grain, three times a day, is probably both efficient and harmless. If the mother be robust, larger, or, still better, more frequent doses may be desirable. The writer has recently seen an infant suffer very severely indeed from syphilis, whose mother had, under the advice of a distinguished obstetrician, taken minute doses of the bichloride through almost her whole pregnancy. Thus we are warned that to be efficient the course must be a real one. Whenever in married life a syphilitic infant has been produced, it is desirable that both parents should be put under treatment, with a view to the safety of future conceptions. There is a drawback to the administration of mercury to a woman actually pregnant, that it may damage the development of the infant's teeth (first set). This makes it the more desirable that the mother should be well treated with the specific before conception.

JONATHAN HUTCHINSON.

CONICAL CORNEA. *See* CORNEA, Variations of Curvature of the.

CONICAL STUMP. *See* STUMPS, Affections of.

CONJUNCTIVA, Diseases of the.—HYPERÆMIA OF THE CONJUNCTIVA.—*Causes.*—The presence of foreign bodies in the conjunctival sac. Impure or irritating atmospheres, e.g. air charged with coal or tobacco smoke. Alcoholic excesses, stenosis lacrymalis, and other forms of lacrymal obstruction. The use of unsuitable spectacles, or the use of the eyes for near work without spectacles when the condition of the accommodation requires them, e.g. in hypermetropia, and in presbyopia.

Pathology.—The blood-vessels of the palpebral rather than those of the bulbar conjunctiva become engorged, slight chemosis sometimes appears, small vesicles may form, and there may be some swelling of the papillæ, and development of lymph-follicles.

Symptoms.—These consist of lacrymation and photophobia, with hot, burning sensations, and a feeling as of a foreign body or sand in the eye, and the eyelids are heavy. All these symptoms are aggravated in artificial light.

Diagnosis.—The only disease for which this condition is likely to be mistaken is simple catarrhal conjunctivitis, of which the symptoms are very similar; but in the latter there is more or less discharge from the mucous membrane, while in hyperæmia of the conjunctiva there is none.

Treatment.—In addition to removal of the cause, the use of iced compresses to the closed eyelids for twenty minutes several times a day, and the instillation of a drop of tincture of opium and distilled water in equal parts once daily, will be found very beneficial. It is also desirable to clear out the lacrymal passages with a stream of fresh water from an Anel's syringe, even where no decided lacrymal obstruction is present.

Conjunctivitis (in general).—In addition to hyperæmia of the mucous membrane, abnormal secretion is here present. There are several forms of conjunctivitis, the secretion from each being, more or less, contagious. Infection may take place either by the direct application of the secretion, or through the air, in which float particles of the infecting substance. The former is the more common mode, but the latter is liable to occur in ill-ventilated rooms, where some people affected with conjunctival disease are present with others possessing healthy eyes.

Catarrhal Conjunctivitis (Simple Acute Conjunctivitis). — *Causes.* — Draughts of cold air, contagion, foul atmospheres, foreign bodies, as a sequel of or attendant on scarlatina, measles, or smallpox.

Pathology.—The hyperæmia of the conjunctiva is here well-marked, often concealing the Meibomian glands, and extending sometimes over to the bulbar conjunctiva as far as the cornea. Enlarged papillæ and lymph-follicles are often present, but not necessarily so. There is a sticky, serous discharge, which sometimes produces ulceration of the intermarginal portion of the eyelid. If the catarrh becomes chronic the papillæ become more developed, while the blepharitis is apt to extend over to the cutis, causing eversion of the lower punctum lacrymale with resulting stillicidium, and this, in its turn, aggravates the conjunctival affection.

The *Symptoms* are very much those of a severe case of hyperæmia (sensation of sand in the eye, hot, burning sensations, weight of eyelids), with the addition of the annoyance caused by the secretion, which gums the patient's eyelids together on his awaking in the morning and, by coming across the cornea, causes momentary clouding of the sight. Photophobia may be present, but is not usually severe unless there be some corneal complication. The latter, sometimes, is seen in the form of minute marginal infiltrations which rarely attain to very serious dimensions, but rather disappear as the conjunctiva becomes normal.

Diagnosis.—The presence of the gummy secretion distinguishes this affection from mere hyperæmia of the conjunctiva. A common mistake amongst those not familiar with eye-disease is to regard a case of iritis as one of simple acute conjunctivitis, the 'redness' of the white of the eye in the former affection being taken for conjunctival hyperæmia, &c., and, moreover, a slight secondary conjunctivitis does, undoubtedly, attend many cases of iritis. The circumcorneal subconjunctival vessels are those which become engorged in iritis, and the conjunctival vessels may be distinguished from them by the possibility of moving them, along with the membrane in which they are, by manipulations which can be made with the lower lid of the patient, but these manipulations do not affect the subconjunctival vessels. The condition of the iris itself, however, is that upon which the diagnosis chiefly depends. *See* Iris.

The *Prognosis* is good unless there be reason to suspect that the mild form is but the commencement of a more severe inflammation.

Treatment.—At the first onset nothing more than iced compresses, used intermittently (twenty minutes every two hours), should be employed, and in mild cases this alone soon brings about a cure. On the second or third day the application, with a camel's-hair pencil, of a solution of five to ten grains of nitrate of silver to one ounce of water by the surgeon to the everted palpebral conjunctiva, is to be recommended; provided it be immediately and thoroughly neutralised by the application of a saturated solution of common salt to the conjunctiva—to prevent too severe a reaction—the whole being washed off finally with plain water. A few daily applications of this kind are usually enough to cure these cases.

Iced compresses, or cold sponging, immediately after the dressing, relieve the smarting.

The greatest care is required in the use of nitrate of silver in conjunctival affections for any prolonged period, lest it cause staining of the membrane; thorough neutralisation and washing, as above recommended, being the best precautions. The writer is opposed to the use even of weak solutions of nitrate of silver as eye-drops to be used at home by the patient, for staining is very apt to be caused in this way.

Should the surgeon be unable to see the patient daily, the following well-known eye-drops are capable of effecting a rapid cure in most cases: ℞ Acid. boracic. gr. viii., Zinci sulph. gr. iv., or Tinct. opii fʒij., Aq. destill. ad f℥ij.; one drop in the eye once a day. Solutions of sulphate of alum (gr. iv. to f℥j. of water) and of tannic acid (gr. v.–viii. to f℥j. of water) are often prescribed, but are not so effectual as the foregoing.

FOLLICULAR CONJUNCTIVITIS. — *Causes.* These are much the same as in simple catarrhal conjunctivitis. The long continued use of either atropine or eserine is liable to bring about the disease.

Pathology.—The condition of the conjunctiva is that found in catarrhal conjunctivitis, with the addition of small, oval, pinkish bodies the size of half a carraway-seed, which disappear completely as the disease passes off, leaving the mucous membrane as healthy as they found it. These little bodies are situated chiefly in the fornix of the conjunctiva, especially of the lower lid, and may be seen, on eversion of the latter, arranged in rows parallel to the margin of the lid. Whether they be easily discovered or not depends on their size and number, and on the amount of co-existing hyperæmia or chemosis of the conjunctiva. The structure of these bodies shows them to be lymph-follicles. They have no relationship to the granulations of granular ophthalmia, although some authors have regarded them as an initial stage of the latter.

The symptoms are much the same as those of catarrhal conjunctivitis. Frequently there is little or no injection of the conjunctiva, and the chief symptom is asthenopia—an inability to continue near work for any length of time—and much distress in artificial light. The presence of even a few follicles in the conjunctiva may cause annoying symptoms of this kind. Between the fifth and fifteenth years of age is the time of life most liable to it.

Prognosis.—Follicular conjunctivitis is a most tedious form, lasting often for months, and this is the most serious point in connection with it. Slight marginal infiltrations and ulcers of the cornea sometimes occur in its course.

Treatment.—The most useful remedy is an ointment of sulphate of copper of from gr. ss. to gr. ij. in ʒj. of vaseline. The weaker ointment should be used at first, and later on the stronger ones, if it is found that the eye can bear them. A piece of ointment of the size of half a pea is inserted into the conjunctival sac with a camel's-hair pencil once a day. Eye-drops of equal parts of tincture of opium and distilled water are of use in some cases, and the eye-douche should be recommended. Abundance of fresh air, with change from a damp climate or neighbourhood, if the patient live in such, to a dry one, are of importance. If the use of atropine has induced the disease, it should be discontinued, and, if a mydriatic be still required, a solution of extract of belladonna (gr. viii. ad f℥j.) may be employed in its stead.

SPRING CATARRH is the eye-complication which accompanies 'hay fever.' It is not, strictly speaking, a catarrhal affection, for it is usually unattended by secretion, and the prefix 'spring' is misleading, as it is seen also in summer and autumn. The hay harvest is the most common period for it, owing, probably, to certain minute particles which then float in the air.

Pathology.—The bulbar conjunctiva is chiefly affected. It becomes injected, slightly œdematous, and close around the cornea somewhat elevated, with greyish swellings. The microscope shows (Uhthoff) that this swelling is due to hypertrophy of the epithelial layer of the conjunctiva in this situation, combined with subepithelial infiltration with a substance which is, or is similar to, coagulated albumen. The connective tissue layer of the conjunctiva remains tolerably normal.

Symptoms.—The chief symptoms are photophobia and lacrymation.

Some persons are liable to be attacked at each hay harvest.

Treatment.—Dark glasses for protection from the light. Weak astringent collyria (sulphate of zinc, acetate of lead). Or, iodoform ointment (1 in 15), a little put into the eye once a day. Massage applied twice daily, in conjunction with strong precipitate ointment, is a treatment recommended by some. Occasional cold sponging, or the eye-douche, are grateful to the patient.

Granular Conjunctivitis, Granular Ophthalmia, or Trachoma.—This disease occurs in two forms, the acute and the chronic.

Causes.—The disease is regarded as very contagious. The acute form is said to be often epidemic in places where the hygienic conditions are bad, but it has not come under the notice of the writer in this form. He has seen only some sporadic cases. The chronic form is much more common. It is very frequent in countries where the dwellings are overcrowded and dirty, and where the climate is damp, as is the case in Ireland amongst the lower orders. Amongst the better classes of all countries the disease is very uncommon. High, dry, mountainous countries are almost free from the disease. Some believe that it is dependent upon constitutional disease, such as scrofula, tuberculosis, syphilis, &c., but this is incorrect. No doubt many of these patients are anæmic and out of health; but this is due to the moping habits they contract and the little open-air exercise they take, in consequence often of their semi-blindness.

Pathology.—In this disease, in addition to the usual appearances of simple conjunctivitis, there are developed greyish or pinkish-grey bodies in the conjunctiva, each about the size of the head of a pin or larger. They attack, especially, the fornix conjunctivæ of the upper lid, but are also found disseminated over other parts of the palpebral membrane. They do not attack the bulbar conjunctiva. These bodies are the 'granules' or 'granulations,' and in the acute form of the disease they somewhat resemble the follicles of follicular conjunctivitis, but are paler, not so apt to occur in rows, and are more isolated. Microscopically the granulations have no capsule, as have the follicles, but seem to grow from, or in, the stroma of the conjunctiva. In the acute form the granulations consist of lymph-cells alone; but in the chronic form this is the case only towards their surface, while at their bases they are formed chiefly of connective tissue. Sattler has discovered the presence of a peculiar micrococcus in the interior of the granulations and in the secretion, and to this probably is due the marked infectiousness of the disease. The danger associated with these granulations, and one of the chief dangers of the disease, is the tendency they have to produce cicatricial degeneration of the mucous membrane. In some cases the whole conjunctiva is destroyed; and xerophthalmia, which may involve even the bulbar conjunctiva, may come on, but this is not very common. A more frequent result is that the submucous tissues, including the tarsus of the eyelid and the bulbs of the eyelashes, become secondarily affected, with resulting entropion, distichiasis, and trichiasis.

An affection of the cornea, termed *pannus*, is very frequently seen as a result of granular ophthalmia. Its occurrence does not seem to depend on the severity of the conjunctival disease, for it may be found in slight cases of the latter, or at least where the granulations and consequent conjunctivitis are not very markedly developed. This pannus consists in opacity and superficial vascularisation of the cornea, and always commences in its upper half. *See* Cornea, Inflammation of the.

Symptoms.—In acute granular ophthalmia there is often a great deal of swelling of the upper lid, great injection of the whole of the bulbar and palpebral conjunctiva, and swelling of the papillæ with development of the characteristic granulations. There may be but little discharge, but there is generally much lacrymation, with photophobia and pain in the brow and eye. Superficial marginal ulcers of the cornea may form. The inflammation and papillary swelling is, sometimes, almost absent in the very commencement. Soon, however, they appear and gradually increase to such an extent as to hide the granulations from view, and then, taking on a blennorrhœic form, the process gradually subsides, until, in the course of two or three weeks, it quite disappears, having brought about absorption of the granulations, and ultimately the mucous membrane is left in a healthy state. If, however, in the blennorrhœic stage, the inflammation be severe, the eye may run all the dangers of an attack of acute purulent conjunctivitis. Or, if, on the other hand, the inflammation be very slight, it may not be sufficient to effect absorption of the granulations, and the process may run into the chronic form.

In chronic granular ophthalmia the first onset of the disease is often without inflammation, and is then unattended by any distressing symptoms, except that the eye may be more easily irritated by exposure to cold winds, foreign bodies, &c., or more easily wearied by reading and other near work. If such a case come under our notice, the conjunctiva will be found free from injection and swelling, but greyish-white semitransparent granulations of the size of a rape seed, or less, will be seen disseminated over the palpebral conjunctiva and protruding from it. Gradually these granulations, acting as foreign bodies, give rise to a more or less active vascular reaction, attended with swelling of the papillæ—in short, to blennorrhœa of a chronic form. The patients then begin to be more inconvenienced, owing to the discharge, which obscures their vision, and to sensations of weight in the eyelid and of foreign bodies in the eye, and this is generally the earliest stage at which we see the disease. The enlarged papillæ sometimes grow to a great size, completely hiding the granulations. In this stage the granulations may become absorbed, and the disease undergo cure, but more commonly it makes further progress. Fresh granulations appear, while the old ones increase in size, until they often become confluent, leaving only here and there an island of vascular mucous membrane, and the stage of cicatrisation is present.

At any period prior to cicatrisation of the conjunctiva an attack of purulent blennorrhœa is liable to come on. If not too severe, this may result in cure by absorption of the granulations, and should not be checked. If, however, the attack be very severe, the eye runs dangers similar to those of an ordinary attack of purulent conjunctivitis. These dangers are less, the more complete and the more intense the pannus.

Prognosis.—On the whole, if the disease come under treatment at an early period, it may be hoped that vision will be retained in the majority of cases, although a radical cure may be difficult or impossible. These cases require to be under constant or intermitting treatment for long periods, often for years.

Treatment.—The aim of this is to bring about absorption of the granulations with the greatest possible despatch, in order to prevent the destruction of the mucous membrane to which they tend. No caustic application should be made with the object of directly destroying the granulations, for this can only be done at the expense of the mucous membrane around them. If at the first visit any difficulty be found in everting the upper lid, it is advisable, in bad cases of granular ophthalmia, acute or chronic, to at once perform a canthoplastic operation (*see* EYELIDS, Diseases of), as this tightness of the eyelid is an obstacle to the cure.

In acute granular ophthalmia it is desirable to abstain from active measures in the commencement of the affection, owing to the tendency to natural cure which is often present, and, in particular, astringents and caustics should be avoided. At the utmost an antiseptic lotion of boracic or salicylic acid, and cold, or iced, applications for relief of the pain and heat, are admissible. Dark protection-glasses are agreeable, and, wearing them, the patient should be encouraged to take open-air exercise. But, if it be evident that the inflammatory reaction is too sluggish, poultices or warm fomentations should be employed to promote it. Once the blennorrhœic stage has been reached, great care is required to control it, and, if it threaten to exceed safe bounds, it must be restrained by means of suitable applications, such as acetate of lead, nitrate of silver, or sulphate of copper in solutions of medium strength; or it may be necessary to use them in strong solutions, or even to employ the solid mitigated nitrate of silver, according to the severity of the blennorrhœa.

In chronic granular ophthalmia, as already stated, the occurrence of a blennorrhœic attack often produces marked improvement. Following the hint nature thus gives us, we should endeavour by our treatment to produce a certain papillary reaction (blennorrhœa). For chronic cases, with little swelling of the papillæ and with little or no cicatrisation, the best application is the solid sulphate of copper lightly applied to the conjunctiva, especially at its fornix, but, when there is considerable papillary swelling, the writer prefers a 10 grain to Aq. f℥j. solution of nitrate of silver, properly neutralised, after application, with a solution of salt. An interval of twenty-four hours, at least, should be allowed to elapse between each application, whether of sulphate of copper or nitrate of silver, and cold sponging for fifteen minutes should be employed immediately after the application. A change of treatment will be required occasionally, even if the remedy first used answer well in the beginning, and one of the following can be adopted:—Liq. plumbi acetatis dil., never to be used except with everted lids, and washed off with plain water by the surgeon, and not even in this way if there be ulcers of the cornea, as a deposit of acetate of lead on the ulcer is liable to occur. Tannin ointment: tannin, gr. iij., vaseline, ʒiij.; a piece the size of half a pea to be put into the eye once a day. Sulphate of copper ointment: same strength as the last, and to be used in the same way. Solution of alum: gr. x. to f℥j. of distilled water; one drop in the eye once a day. Where an active pannus is present, a drop of solution of atropine should be instilled into the eye once a day, as a precaution against iritis.

Some surgeons employ scarifications of the conjunctiva when it is much swollen and the papillæ too exuberant, but the writer has not adopted them, fearing the resulting cicatrices. Again, it has been proposed to excise or abscise the granulations. This may, perhaps, be allowable if they are isolated and protrude much over the conjunctival surface. Electrolysis has been employed for the destruction of the granulations, but the method has not as yet been generally adopted. It is worthy of further trial. The negative pole, in the form of a needle, is plunged into the granulation, while the positive pole is placed either on the temple or other adjacent region.

Inoculation of the conjunctiva with pus from a case of blennorrhœa neonatorum has been much practised in Belgium, especially in cases of severe pannus. By this means a violent acute blennorrhœa is set up, which is then guided to a cure; and, when it has subsided, the granular ophthalmia and pannus should have disappeared. This method is attended with considerable danger to the cornea, even where the pannus is well developed, and has not, therefore, found general acceptance.

Infusion of jequirity (*Abrus precatorius*, Paternoster-bean), long used in the Brazils, has been introduced to the notice of European surgeons by De Wecker. A 3 per cent. infusion is applied morning and evening, or even three times daily, for two or three days. The affected eyelids are everted, and the infusion is applied plentifully to the conjunctiva with a sponge, or it may be rubbed into the mucous membrane. The result is a purulent ophthalmia of a somewhat croupous tendency (the cornea being hidden by a false membrane), accompanied by great swelling of the eyelids, much pain and considerable constitutional disturbance, rapid pulse, and a temperature of 100° or more. In the course of eight or ten days the inflammation subsides, and the cornea is then, in many cases, found free from pannus, or almost so, while complete cure of the granular ophthalmia itself is rarer. Iced compresses to the lids should be used during the inflammation. A fresh infusion (not more than seven days old) must be used, in order to have the most certain effect from the application. The majority of surgeons find the remedy perfectly harmless, if not always very efficacious; but a good many cases are on record where violent diphtheritic conjunctivitis, followed by blennorrhœa of the conjunctiva, and by more or less extensive ulceration and destruction of the cornea, and even complete loss of the eye, was produced. De Wecker regards the presence of a purulent discharge from the conjunctiva as a contraindication for the remedy, which, he finds, is then liable to increase the intensity of the blennorrhœa in a dangerous degree. Cases where there is little or no papillary swelling, but nearly dry granulations with pannus, are the most suitable for its use. The presence of well-marked pannus of the cornea without ulceration is, in the opinion of a large number of surgeons, the only thing which can render the employment of jequirity justifiable, and, in addition to this, the conjunctiva should be free from blennorrhœa.

In addition to local remedies, it is of the utmost importance that the hygienic surroundings of patients suffering from granular ophthalmia be seen to, and that they be obliged to spend a considerable time daily in the open air.

PURULENT OPHTHALMIA. — *Causes.* — The two most common forms in which we find this affection are, as gonorrhœal ophthalmia, and as ophthalmia neonatorum. In the former the etiological element is the introduction of some of the urethral or vaginal discharge into the conjunctival sac, while in the latter the infection is believed to take place, as a rule, during the act of birth, by an abnormal secretion (not necessarily gonorrhœal) of the vagina finding its way into the infant's eyes. For, although the eyelids are closed during birth, they are not so tightly closed as to preclude the possibility of fluid making its way between them. Ophthalmia neonatorum may also be the result of inoculation taking place after birth by pus conveyed by the fingers of the mother or nurse, or by towels, &c., used for washing the child's face. It is never due to mere exposure to strong light or to cold, as is popularly supposed. Acute conjunctival blennorrhœa also comes about without any assignable cause; but, in all these cases, it is probable that the introduction of some septic matter into the eyes has taken place, although without the knowledge of the patient.

Pathology.—Neisser, who first observed the presence of a peculiar micrococcus in the gonorrhœal discharge, also found the same micrococcus in the pus from the conjunctiva in cases of gonorrhœal ophthalmia, and it was thought that this might account for the remarkable virulence of this ophthalmia; the same micrococcus, however, has been found in the conjunctival discharge in ophthalmia neonatorum.

Symptoms and Progress.— In mild cases the bulbar conjunctiva may be but little, or not at all, affected; the palpebral conjunctiva alone becoming velvety and discharging a small amount of pus, while there may be no swelling or œdema of the eyelids. Such mild cases are not uncommon in ophthalmia neonatorum. In severe cases of blennorrhœa of the conjunctiva there is, soon after the onset, serous infiltration of the palpebral mucous membrane, which consequently becomes tense and shiny; serous chemosis of the bulbar conjunctiva, serous discharge, swelling of the eyelids, making it difficult to evert them, pain in the eyelids, often of a shooting kind, burning sensations in the eye, and photophobia. This first stage lasts from twenty-four to forty-eight hours, and then begins the second stage, in which, owing to swelling of the papillæ, the palpebral conjunctiva becomes less shiny and more velvety, while the discharge alters from serous to the characteristic purulent form, the chemosis, however, remaining unaltered, or becoming more firm and fleshy. The swelling of the lids continues, the upper lid often becoming pendulous and hanging down over the under lid. Gradually the chemosis and the swelling of conjunctiva and eyelids subside, and the discharge lessens, the mucous membrane being left in a normal state, unless in a small percentage of cases in which chronic blennorrhœa remains. A severe attack of conjunctival blennorrhœa lasts from four to six weeks.

Complications with secondary corneal affections are the great source of danger in this affection. They occur in four forms:—1. Small losses of epithelial tissue on any part of the cornea. If these occur at the height of the inflammation, they are apt to go on to form deep perforating ulcers. 2. The whole cornea becomes opaque (diffusely infiltrated), and towards its centre some greyish spots form, which are interstitial abscesses or purulent infiltrations. 3. The infiltration may form at the margin of the cornea, and extend a considerable distance around its circumference, giving rise to a marginal ring ulcer, and, later on, to sloughing of the whole cornea. 4. A clean-cut ulcer may form at the margin of the cornea without any purulent infiltration of the corneal tissue, and may also extend a long way round the cornea. Such ulcers are particularly apt to occur where there is much chemosis which overlaps the margin of the cornea, and, being hidden in this way, these ulcers are easily overlooked. The chemosis should be pushed aside with the point of a probe, and these peculiar ulcers sought for. They are very liable to perforate. See *Suppurative Keratitis*, under Cornea, Inflammation of the.

All the foregoing forms of secondary corneal affection are common to ophthalmia neonatorum and gonorrhœal ophthalmia, but the two last are more frequent in gonorrhœal ophthalmia than in that of the newborn. They may appear at any period of the affection, but the earlier they occur the more likely they are to result seriously.

Treatment.—In the commencement of the affection the only local applications admissible are antiseptic lotions and iced compresses. The conjunctival sac should be frequently washed, not syringed out, with the former. In syringing out the conjunctival sac a morsel of the corneal epithelium may be removed, and through this the cornea become infected, and consequently this method is objectionable. The iced compresses should be kept to the eye for an hour at a time, with a pause of an hour, and so on, or even continuously. In this and in the next stage the chemosis should be freely and daily incised with scissors. If the swelling of the eyelids be great, the external canthus should be divided with a scalpel from without, leaving the conjunctiva uninjured; by which means the tension of the eyelids on the globe is reduced, and, by bleeding from the small vessels, depletion of the conjunctiva is effected. If, in adults, the degree of chemosis, palpebral swelling, and rapidity of the onset, indicate that the inflammation is severe, the writer is in the habit of placing the patient quickly under the influence of mercury, by means of inunctions or small doses of calomel, as, by this means the chemosis is often rapidly brought down, and one source of danger to the cornea removed. He does not use mercury in ophthalmia neonatorum.

In the second stage, i.e. when the conjunctiva has become velvety and the discharge purulent, caustic applications are the most trustworthy, and in this respect iodoform, and other lauded means, cannot compete with them. The application employed may be a solution of nitrate of silver of 15 to 20 grains in f℥j. of water, which should be applied by the surgeon with a camel's-hair pencil to the conjunctiva of the everted lids, and neutralised with a solution of common salt. Or, the solid mitigated nitrate of silver (one part nitrate of silver, two parts nitrate of potash, in the solid form as stick) may be used; the first application being a light one, in order to test its efficacy, when careful neutralisation with salt water, immediately followed by washing off with fresh water, are most important. After each caustic application the use of iced compresses for an hour is beneficial.

The immediate effect of a caustic application to the conjunctiva is the production of a more or less superficial slough, under which a serous infiltration takes place. This latter increases and finally throws off the slough, and then the epithelium begins to be re-formed. From the time the slough separates until the epithelium has been regenerated a diminution in the secretion may be noted; but the discharge again increases as soon as the regenerative period is ended, and this latter is the moment for a new application of the caustic. From one caustic application of ordinary severity until the end of the regenerative period about twenty-four hours usually elapse.

No corneal complication contraindicates the active treatment of the conjunctiva just described; but, when a corneal ulcer is present, care must be taken that, during eversion of the lids, no pressure is made on the eyeball, lest the floor of the ulcer give way.

Iodoform, finely pulverised, has recently been much praised as a local application in the second stage of acute blennorrhœic conjunctivitis. It is to be dusted freely on the everted conjunctiva once or twice a day. The writer would trust to it in mild cases only.

When only one eye is affected it is important to protect its fellow from infection by means of a hermetic bandage. This may be made by applying to the eye a piece of lint covered with boracic acid ointment, and over this a pad of salicylicated cotton wool. Across this, from forehead to cheek and from nose to temporal region, are laid strips of lint, soaked in collodion, in layers over each other; or a piece of tissue gutta-percha may take the place of the lint and collodion, its margins being fastened to the skin by collodion. The shields invented by Maurel and Buller respectively are very serviceable for this purpose.

The *prophylaxis* of blennorrhœa neonatorum is very important, and should form part of the routine of lying-in practice. Careful disinfection of the vagina before and during birth, and the most minute care in cleansing the face and eyes of the child with a non-irritating disinfectant (e.g. solution of corrosive sublimate, 1 in 1000), immediately after birth, are to be recommended. The antiseptic lotion should be freely poured into the eyes, the lids being held open for the purpose. The method of Dr. Credé has found very general acceptance, and is a good one. It is as follows:—While, after division of the umbilical cord, the child is in the bath, the eyes are carefully washed with water from a separate vessel, the lids being scrupulously freed, by means of medicated wool—absorbent or borated—of blood, slime, or smeary substance; then, before the child is dressed, a few drops of a 2 per cent. solution of nitrate of silver are instilled into the eye.

Treatment of Corneal Complications.—Many surgeons use solution of the sulphate of eserine (gr. iv. ad Aq. f℥j.) dropped into the eye as soon as any corneal complication arises and as long as it continues, because this drug is believed, in addition to its myotic power, to have the effect of reducing the intra-ocular tension (a circumstance to be desired in these instances) and to act, also, as an antiseptic. Its power to reduce the normal intra-ocular tension is not great, and its antiseptic action, if it exists, must be very insignificant, while, on the other hand, in the writer's opinion at least, it has a decided tendency to promote iritis in these cases, where the iris is so liable to become inflamed secondarily to the corneal process. For these reasons the writer does not recommend its use in these cases. His own practice is to employ atropine here, with the object of diminishing the tendency to iritis, by keeping the muscles of the iris and ciliary body at rest. Only if a marginal ulcer should perforate, with prolapse, or danger of prolapse, of the iris into the opening, would eserine seem to be indicated, and then simply for the purpose of mechanically drawing the iris out of, or away from, the perforation by the contraction of its sphincter.

On the first appearance of an infiltration or ulcer of the cornea, besides the use of atropine, nothing can be done further than the steady continuance of the conjunctival treatment, no remission or relaxation of which is indicated. Greater care, however, is required in everting the lids, lest pressure on the globe might cause rupture of the ulcer; and, when a case of acute blennorrhœa of the conjunctiva first presents itself, the surgeon, not knowing the condition of the cornea, must use the utmost caution in making his examination, and yet must never fail to get a view of the cornea for the purposes both of prognosis and of treatment. At each visit the cornea must be examined, and it may be found that, as the conjunctival process subsides, the corneal affection also progresses towards cure, infiltrations becoming absorbed, and ulcers filling up. But, even though the conjunctiva be improving, and still more so if it be not, the corneal process may progress, the infiltration becoming an ulcer, and the ulcer going on towards perforation by becoming gradually deeper. (For the management of the corneal complications see *Suppurative Keratitis, Ulcers, &c.*, under CORNEA, Inflammation of the.)

Central capsular, or pyramidal, cataract may be the result of a small perforating corneal ulcer in blennorrhœa neonatorum. On perforation taking place, the lens, or rather its anterior capsule, comes to be applied to the posterior aspect of the cornea, owing to there being now no anterior chamber, as the aqueous humour has escaped through the opening. The pupillary area is soon filled with fibrinous exudation, the opening in the cornea finally becoming closed, and the iris and lens are pushed back into their places by the aqueous humour, which has again collected. Adherent to the anterior capsule, on the spot which lay against the cornea and which corresponds with the pupillary area, is a morsel of fibrin, which in the course of time becomes absorbed by the aqueous humour. Meanwhile changes have been produced by this exudation on the corresponding intracapsular cells, which result in a small permanent central opacity at that place, where there is also a slight elevation of pyramidal shape over the level of the capsular surface. This is the condition called central capsular cataract, and rarely results from corneal perforation in adults. *See* CATARACT.

It will frequently occur that, on the surgeon's visit to a case of blennorrhœa of the conjunctiva, he will find the margins of the eyelids gummed together by sero-purulent secretion, while the eyelids are bulged out by the pent-up fluid behind them. The attempt to open the eye should then be very carefully made, lest some of the retained pus spurt into the surgeon's eye. The surgeon should also be most careful to thoroughly wash and disinfect his hands and nails immediately after his examination is concluded.

CROUPOUS CONJUNCTIVITIS.—*Causes.*—Contagion. Epidemic.

Symptoms and Diagnosis.—This disease is chiefly found in children, and is not common. The palpebral conjunctiva is a good deal swollen, and is covered with a delicate smooth grey false membrane that may be peeled off, leaving a mucous surface underneath, which then bleeds little, or not at all. The disease is not a severe one, and does not often cause secondary corneal affections. It must not be mistaken for diphtheritic conjunctivitis, from which it is easily distinguished by the readiness with which, in it, the false membrane can be removed, and by the vascular condition of the underlying mucous membrane.

Treatment.—Iced compresses to the eyelids during the croupous stage, with antiseptic cleansing of the conjunctival sac (Sol. hydrarg. perchlor., 1 in 2000, or Sol. acid. borac. 4 per cent). No caustic should be used in this stage, as it is apt to produce corneal changes. Sulphate of quinine sprinkled on the conjunctiva is praised by some surgeons as a useful application in this stage. When the false membrane ceases to be formed a slight blennorrhœa comes on, which may be treated on the principles above laid down.

DIPHTHERITIC CONJUNCTIVITIS.—*Causes.* This disease is very rare in the United Kingdom, but is not infrequent in some parts of Germany. It is difficult to assign a cause for it. It is frequently epidemic, and is extremely infectious.

Symptoms and Diagnosis.—There is no more serious ocular disease than this, for it may destroy the eye in twenty-four hours, while in severe cases treatment is almost powerless.

The subjective symptoms of its initial stage are similar to those of blennorrhœic conjunctivitis, although the pain especially is more severe. The objective symptoms differ from those of blennorrhœa, in that the lids are excessively stiff from plastic infiltration of the subepithelial and deeper layers of the conjunctiva, while the surface of the mucous membrane is smooth, and of a greyish or pale buff colour. The bulbar as well as the palpebral conjunctiva is infiltrated in severe cases. If an attempt be made to peel off some of the superficial exudation, the surface beneath will be found of the same colour, not red and vascular as in croupous conjunctivitis. This stage of infiltration lasts from six to ten days, and constitutes the period of greatest peril to the eye; for, while it lasts, sloughing of the cornea is extremely apt to occur. Towards the close of the first stage the fibrinous infiltration is eliminated from the conjunctiva, which gradually assumes a red and succulent appearance, and secretes a purulent discharge. This constitutes the second or blennorrhœic stage. A third stage is formed by cicatricial alterations in the mucous membrane, which often lead to symblepharon or xerophthalmos; so that, even if the patient escape corneal complications in the first and second stages, other dangers, almost as serious, await him in the final stage. *See* XEROSIS or XEROPHTHALMOS.

Corneal complications (infiltrations, ulcers) are most likely to occur in the first stage, and are then also most likely to prove destructive to the eye. The earlier they appear the more dangerous are they. The corneal complications are more easily managed, if they do not appear until the blennorrhœic stage has commenced, or even if the latter stage come on before an ulcer contracted in the first stage has advanced far.

Treatment.—In the first stage, warm fomentations frequently, with antiseptic cleansing, are the only local measures for the conjunctiva admissible. No caustic or astringent application should be used. Internally the patient should be treated with iron and quinine, and generous diet. In the second, or blennorrhœic, stage, careful caustic applications are to be used. Corneal ulcers must be dealt with, whenever they arise, as though the case were one of blennorrhœic conjunctivitis. When the purulent discharge ceases, solutions of soda, milk, or glycerine may be prescribed as lotions for the conjunctiva, to arrest, if possible, the xerophthalmos.

Phlyctenular Conjunctivitis. — *Causes.*—The strumous constitution—as indicated by the swollen nose and upper lip, and sometimes by the enlarged lymphatic glands in the neck, and by eczema of the eyelids, face, and external ear, and catarrh of the Schneiderian mucous membrane—is that most liable to this affection, the subjects of which are usually children up to the twelfth or thirteenth year of age. Often, however, it will be found in apparently strong children with good general health; but, even in them, there is probably some allied irregularity of nutrition, of which the great tendency to recurrence of the eye-affection is evidence.

Pathology. — This is an eczematous affection, and is characterised by the eruption of vesicles or pustules on the bulbar conjunctiva—so-called phlyctenulæ.

Symptoms.—Two types of the eruption are to be recognised: 1. The solitary, or simple, phlyctenula. Of this there may be one or several, varying in size from 1 mm. to 4 mm. in diameter. Around the phlyctenula is a localised vascular injection, but the general conjunctiva is normal. At first there may be shooting pains in the eye and lacrymation, but these soon pass away. If a phlyctenula be not seated close to the cornea—which might in that case become infiltrated—the affection is not serious. The length of time required for its cure depends on the size of the phlyctenula, varying from seven to fourteen days, as a rule. 2. The multiple, or miliary, phlyctenulæ. These are minute, like grains of fine sand, and are always situated on the limbus of the conjunctiva (i.e. that portion of the bulbar conjunctiva which immediately surrounds the margin of the cornea), which is swollen. The general injection and swelling of the conjunctiva, in this form, is considerable. The lacrymation and photophobia are often very great, and there is a good deal of conjunctival discharge. This form is very apt to appear after measles and scarlatina.

Both forms are liable to extend to the cornea, and then only does the disease become serious. *See* Cornea, Inflammation of the.

Treatment.—The solitary phlyctenula is best treated with the yellow oxide of mercury ointment (Pagenstecher's Ointment: ℞. Hydrarg. perox. præcip. gr. xxx., vaselin ℥j.), of which a bit the size of a hemp-seed should be put into the eye once a day. Or a small quantity of pure calomel dusted into the eye once a day will also cure. This last remedy should not be used if—as is indeed unlikely—iodide of potassium is being at the same time taken internally, for then iodide of mercury is liable to be formed in the conjunctiva.

The miliary phlyctenular conjunctivitis at its outset should be treated with cold or iced applications; or, at most, some freshly-prepared solution of Liq. chlori (1 part Liq. chlori, 9 parts water), may be dropped into the eye. Later on Liq. plumb. dil. or Sol. arg. nitr. (gr. v. ad Aquæ f℥j. and neutralised), applied to the everted conjunctiva, are suitable; or, if the phlyctenular appearances predominate over the catarrhal, the yellow oxide of mercury ointment, or insufflations of calomel, may be preferred. When the cornea is slightly affected near the margin, in cases of miliary phlyctenulæ, calomel, or the yellow oxide of mercury ointment, and warm fomentations should be used.

The after-treatment of phlyctenular conjunctivitis is important, in order to prevent recurrence of the affection. It consists in the insufflation of a minute quantity of calomel into the eye once a day, until, on awaking in the morning, the eye is found to be quite free from vascular injection. This after-treatment may require to be continued for three or four weeks.

Conjunctival Complication of Small-pox.—A good deal of uncertainty has prevailed with regard to this affection, as the initial stages were not observed by physicians owing to swelling of the eyelids, while the ophthalmologist saw only the results of the process in the period of convalescence from the general disease, or later. The following embodies the view of Professor Horner, who made a special study of this matter throughout a severe epidemic of smallpox.

Smallpox pustules on the cornea are extremely rare. Horner saw but one case. The most frequent and most serious mode of attack consists in a greyish-yellow infiltration of the conjunctiva close to the lower margin of the cornea, not extending to the fornix conjunctivæ, nor far along the inner or outer margin of the cornea. It occurs in the eruptive stage, and is to be regarded as a variolous pustule. This infiltration or pustule gives rise to a corneal affection, either in the form of a marginal ulcer, or as a deep purulent infiltration, ulcerating, perforating, leading to staphyloma, purulent irido-choroiditis and panophthalmitis, results which are often first observed long after the primary conjunctival affection has disappeared. The germ of the conjunctival affection probably makes its way between the eyelids. This theory would account for the constancy of the position of the primary affection—that part of the conjunctiva, with closed eyelids and eyeball consequently rotated upwards, being the most exposed to particles entering.

Treatment.—On this ground the prophylactic use of boracic acid ointment on lint applied over the eyelids is to be recommended. If a conjunctival pustule has already formed without any, or with only commencing, corneal affection, Horner advises the destruction of the pustule with fresh Liq. chlori, or with mitigated lapis (Arg. nitr. 1 part, Potassæ nitr. 2 parts, in the solid form as stick), carefully neutralised with solution of common salt after application. Corneal complications are treated as in blennorrhœa or diphtheritis of the conjunctiva.

The frequency with which the eyes become affected varies in different epidemics of smallpox.

Amyloid Degeneration of the Conjunctiva.—*Cause.*—This rare disease is not associated with amyloid disease in any other part of the system. It seems sometimes to be developed from granular ophthalmia, but occurs also as a primary disease.

Symptoms and Diagnosis.—The affected eyelid is much swollen, but there is a complete absence of all inflammatory symptoms. The patient can but partially elevate his lid, which is so stiff and hard that it is everted only with difficulty by the surgeon. The conjunctiva has the appearance of white wax. The positive diagnosis may be made by submitting a small portion (removed) of the diseased conjunctiva to the iodine test.

The disease attacks chiefly the palpebral conjunctiva, but is also seen in the bulbar portion. It ultimately extends to the cartilage and is a strictly local disease, unassociated with amyloid degeneration in other parts of the system.

Treatment.—When feasible, removal of the diseased parts by the knife and scraping is the only measure possible.

Tubercular Disease of the Conjunctiva.—This is an extremely rare disease. It commences in the bulbar or palpebral conjunctiva as small, pale, yellowish nodules, which soon ulcerate. The ulcers are apt to extend very widely, in one case the whole of the bulbar conjunctiva and part of the palpebral conjunctiva having become involved. The margins of the ulcers are irregular but well-defined, and their floors covered with a pale yellowish creamy deposit. The surrounding conjunctiva is swollen, and, if the palpebral conjunctiva be much involved, the lid becomes enlarged in every dimension.

Symptoms.—There is often no pain, or only a slight burning sensation; but, again, when the ulceration is extensive, very severe pain may come on.

Diagnosis.—Secondary syphilitic disease is that most apt to simulate the appearances of tubercular disease in the conjunctiva. The absence of a syphilitic taint, the presence of tubercular disease elsewhere in the system, or the existence of well-marked family tuberculosis would all point to the disease being of tubercular nature; but the most certain method of diagnosis will lie in the microscopic examination of morsels removed from the nodules or ulcers, and, above all, in inoculation experiments made with such morsels.

Treatment.—Tonics, especially cod-liver oil, are indicated. But inasmuch as the disease is apt to spread to other tissues of the eye (cornea, sclerotic, iris, choroid), the destiny of these eyeballs is, probably in most cases, enucleation. H. R. Swanzy.

CONJUNCTIVA, Injuries of the.—Foreign bodies frequently make their way into the conjunctival sac and cause much pain, especially if they get under the upper lid, by reason, chiefly, of their coming in contact with the corneal surface during motions of the lid and of the eye.

If the foreign body be under the lower lid it is found by drawing the lid down, and, provided it be not actually embedded in the tissue, it is readily removed with a camel's-hair pencil, or with the corner of a soft handkerchief. But if the foreign body be under the upper lid, it is necessary to evert the latter before it can be reached, Should the foreign body be embedded in the conjunctiva it will require to be removed with a needle suitable for the purpose; and the little proceeding will be made easier, both for patient and surgeon, by the instillation of a few drops of solution of cocaine (two per cent.) into the eye.

The conjunctiva is frequently implicated in severe injuries of the eyelids or eyeball; but the consideration of these cases does not come within the scope of this article. The most common form of injury, which may involve the conjunctiva only, is a burn, by fire, acid, or lime.

In the case of a strong acid getting into the eye, if the patient be seen soon after the occurrence, the whole conjunctival sac should be well washed out with an alkaline solution; while, in the case of lime, a solution of a weak mineral acid is indicated for the purpose. Cocaine may be employed to relieve the pain. Subsequently, protection of the eye, with the use of olive or castor oil dropped into it, will best promote the healing process.

In the case of a severe burn of the conjunctiva the resulting cicatrix is liable to produce a more or less extensive union of the eyelid to the eyeball (symblepharon), which often interferes with the motions of the latter, or even with vision if the cornea be obscured. No measures taken during the healing process can prevent symblepharon if the degree of the burn be such as to bring it about.

In many cases it becomes desirable to relieve the symblepharon by operation. The mere dissection of the lid from the eyeball, with the interposition between the two of morsels of oiled lint, &c., proves futile in these cases. It is always necessary to cover one or other of the resulting wounded surfaces with a layer of mucous membrane, in order to prevent recurrence of the condition. This can be effected in some cases by transplantation of conjunctival flaps with pedicle from a healthy portion of the eyeball, according to the proceeding of Teale (*Ophthal. Hosp. Rep.* vol. iii.), or of Knapp (*Archiv für Ophthalmologie*, vol. xiv. pt. 1). A more universally applicable method is the transplantation of conjunctival flaps without pedicle from another patient on the occasion of enucleation of an eyeball, or from a rabbit's eye, or of a portion of mucous membrane from the lips, or from the vagina (Stellwag). The chief precautions necessary for success in this proceeding are:—That the flap to be transplanted be not applied in its position until all bleeding in the latter place has ceased; that the flap be nothing more than mucous membrane, all submucous tissue being carefully removed; that it be sufficiently large to cover the surface without stretching (and it is to be remembered that the flap shrinks to two-thirds of its size after being detached from its own bed); that the flap be kept moist and warm during the period, as short as possible, which elapses between its detachment and its adjustment; and, finally, that it be kept firmly in its new position by a sufficient number of points of interrupted suture. H. R. Swanzy.

CONTRE-COUP. *See* Head-Injuries, Diagnosis of.

CONTUSIONS. *See* Bruises.

COPAIBA-RASH.—Copaiba not only causes disturbances in the digestive canal, but may, as it is eliminated in the breath and perspiration, give rise to certain slight affections of the respiratory and cutaneous surfaces. The skin affection consists, in most instances, in a bright red roseolar eruption, which is to be found chiefly on the back of the neck and arms, and on the chest. This eruption, which usually causes much itching, appears very soon after the first dose of copaiba has been taken, but often persists for several days after the administration of the balsam has been discontinued. It is never the cause of any marked febrile disturbance. The so-called copaiba-rash of which this is the most frequent form seems to be due to the irritating action of this remedy on a skin that is predisposed to become affected with some form or other of eruption. In some cases the rash is a well-marked and painful urticaria, in others it is decidedly papular, and in others, again, it consists of small dusky patches.

CORACOID PROCESS, Fracture of the.—This process may be broken through at any part between its tip and its base. The injury which, however, is extremely rare, is caused only by great direct violence, as when a wheel passes over the shoulder. It is often combined with other lesions, e.g. dislocation or fracture of the upper end of the humerus, or of the clavicle. When the fracture is beyond the coraco-clavicular ligaments the fragment is drawn down by the muscles connected with it; but when the process is broken at its base the ligaments prevent any marked displacement, and the only symptoms are mobility, crepitus, and pain; but these are often obscured by swelling, or by other lesions that are present.

The *treatment* consists in supporting the elbow, brought forward across the chest, in a sling, so as to keep the muscles at rest. HOWARD MARSH.

CORNEA, Examination of the.—Anatomically, the cornea is usually regarded as consisting of five layers, namely, the epithelium; the anterior elastic layer (Reichert's or Bowman's); the fibro-cellular substance, or *substantia propria*; the posterior elastic membrane (Demours' or Descemet's); and the endothelium. Embryologically, however, there are only three layers, namely, (1) the epithelium and anterior elastic membrane; (2) the proper substance; and (3) the posterior elastic membrane with its endothelium. Each of these embryonic layers has a peculiar mode of development, and there are significant differences in their origin. The anterior layer is derived from the external layer of the blastoderm or epiblast, and is continuous with the epidermis of the external integument, while the middle and posterior layers are derivatives of the mesoblast, and are therefore related to all the fibro-vascular structures of the body, including bones, muscles, blood-vessels, and cutis. This relationship extends not only to the mode of development and the nutrition, but also to pathological changes of these several systems. Lesions of the epithelial layer of the cornea resemble those of the epidermis and superficial layer of the dermis, and are associated with them; lesions of the proper substance are associated with those of the fibro-vascular structures of the body; while lesions of the posterior layer are often associated with toxæmic states in which the serous or synovial membranes are implicated. As concrete examples we may take the association of phlyctenular keratitis with eczema in strumous persons, interstitial keratitis with manifestations of hereditary syphilis, keratitis punctata with gonorrhœal rheumatism.

The cornea is nourished partly by blood and partly by lymph. The blood-vessels are derived from branches of the anterior ciliary arteries, and are, in health, found only at the peripheral portion of the anterior surface, where they form delicate loops near the corneal margin, and anastomose with the vessels of the conjunctiva. The posterior layer and the proper substance of the cornea are nourished by the aqueous humour, which gains access to them through the lymphatic spaces of Fontana, and through the stomata in the endothelium. Consequently, the integrity of these layers depends, more or less directly, upon a healthy state of the ciliary body and iris, by which the aqueous humour is secreted. *See* CILIARY BODY; IRIS.

The cornea is innervated by branches of the ciliary and conjunctival nerves. The greater number of the nerve-branches enter the deeper layers of the cornea, and lose their myelin sheaths. They then form plexuses in the stroma, from which fine branches pass forwards to penetrate the anterior elastic membrane. Here they are arranged in a fine sub-epithelial plexus, from which fibrillæ are given off to end between the epithelial cells as free terminals or in corpuscles.

Pathology.—In the economy of the eye and vision the cornea has at least three separate functions to perform. First, by its texture and general construction it fills in and supports the anterior segment of the globe. Second, by its transparency it permits the admission of light within the eye. Third, by its curvature it so refracts this light that, after passing through the dioptric media, it is brought to a focus upon the retina. Alterations of any one or more of these functions constitute disease. Alterations in nutrition of the cornea may affect either its texture, or its translucency, or its curvature. The cornea may also be the site of neoplasmata of an epithelioid or of a sarcomatous nature; but these are rare.

Physical Examination.—In examining the cornea it is necessary, not only to search the surface, but also the substance and the posterior layer. Attention should also be given to the adjacent structures, more particularly the circumcorneal blood-vessels, the anterior chamber, and the iris. This can best be done by adopting a definite plan of inspecting by direct light, by oblique illumination, by the ophthalmoscopic mirror, and by palpation.

1. Examination of the cornea by direct light is most conveniently done by placing the patient opposite a window, so as to obtain a reflection of the window on the cornea. If the eye be made to follow the observer's finger, moving in various directions of the visual field, it is easy to observe whether the polish and lustre of the surface is disturbed or not. If the surface be intact the image will be unbroken in every position; but if it be uneven, whether from cicatrisation, ulceration, or the pre-

sence of a foreign body, the reflection is broken.

2. In oblique or focal illumination, the patient is placed by the side of a lamp, while the light is concentrated on the cornea by a convex lens of about three-inch focal length. By this means, not only the surface, but the substance and deeper layers of the cornea may be thoroughly examined for opacities, foreign bodies, or breaches of continuity.

3. Transmission of light into the eye by means of the ophthalmoscopic mirror not only discloses the presence of opacities, but is often the only means of discovering irregularities of conical cornea, semi-transparent facets, or fine nebulæ.

4. Palpation is less applicable to the cornea than to some other organs, but it may assist diagnosis, either by eliciting alterations of tension or of sensibility. In health the cornea is exquisitely sensitive to touch, but in some neuropathic states it may be hyperæsthetic or anæsthetic in isolated portions, or throughout its whole extent.

JOHN TWEEDY.

CORNEA, Inflammation of the.—KERATITIS OR CORNEITIS.—The phenomena that follow the impaction of a foreign body on the cornea are well known. At first, there is sudden smarting, spasmodic closure of the lids, profuse lacrymation, and redness of the conjunctiva. If the particle be not removed, the manifestations soon undergo some change. The smarting pain is displaced by a dull aching throb above the eyebrow and down the side of the nose, and the sight is dimmed. Coincidently, for some distance around the foreign body the cornea becomes hazy, and a well-defined zone of congested blood-vessels appears around the margin. Still later—especially if the injury be very severe, and the foreign body possess infective properties—the haziness may increase in extent and in intensity; the surface of the cornea ulcerates, pus infiltrates the laminæ and invades the anterior chamber. Eventually perforation may occur, followed by prolapse of the iris and probable destruction of the globe. Inflammation of the cornea may, however, be induced by injury and yet the subsequent course be different, the series of tissue changes culminating in one or other of the forms of keratitis described below; or inflammation may begin without any appreciable injury. The subjective symptoms vary greatly in the different forms of keratitis. There is always more or less pain, together with impairment of sight. Speaking generally, it may be said that inflammation of the anterior layer is more painful than inflammation of the middle and posterior layers; whereas the impairment of sight is usually greater in inflammation of the middle and posterior layers than of the anterior layer.

Pathology.—In all forms of keratitis, whether the inflammation affect the superficial or the deeper layers, there is an appreciable alteration of texture, consisting of an increase in the number of cellular elements and an accumulation of fluid. The canaliculi of the cornea are distended with fluid and with cells. The precise origin of these cells has not been definitively determined. According to Cohnheim and his disciples, all are derived, by a process of diapedesis, from the adjacent blood-vessels, and are in no degree due to the proliferation of the fixed corpuscles, as formerly believed, and as Böttcher still maintains. Experimental evidence goes to show that, in the earlier stages of keratitis, the cells which first congregate are entirely migratory, inasmuch as they are met with before the fixed corpuscles have had time to multiply. Indeed, the advocates of the migratory theory allege that the fixed corpuscles do not proliferate at all, so long as inflammation continues. Whatever change they may undergo is of a retrogressive character. Stricker, Norris, Fuchs, and others believe that the cellular elements of inflammation are derived from both sources. The truth may be that the nature and degree of the inflammation determine what share the blood-vessels and what the tissue-elements shall take in furnishing new cells. If the inflammation be slight, the fixed corpuscles may supply some of the cells; but, if it be severe, these ciliary and conjunctival blood-vessels are probably the sole contributors.

The disposition which the cell-infiltration assumes differs in the different layers of the cornea. When the epithelial layer is affected, the leucocytes are commonly collected into isolated masses, which are called 'phlyctenules' or 'pustules.' When the middle layer is affected the infiltration is more diffused. When the posterior layers are affected the inflammatory product consists mainly of a serous effusion into the anterior chamber, and of deposit of lymph and leucocytes upon the endothelium, corresponding exactly with the changes that occur in, say, serous pleuritis. When the inflammation affects the proper substance, the new cells and the fluid are at first confined to pre-existing channels; but later, the fibrillæ are destroyed, partly by softening and pressure, and partly by the corroding action of the leucocytes. As soon as the fibrillæ are broken the cells wander through the disintegrated cornea, or collect into a circumscribed cavity to form an 'abscess.' If the softening and disintegration lead to an opening on the external surface, the lesion is called an 'ulcer'; if to an opening through the posterior layer, with escape of pus into the anterior chamber, it is called 'hypopyon.'

Repair.—The amount and character of repair which takes place in the cornea depend upon the degree of inflammation. If only the epithelium have been implicated, it is reproduced without leaving any scar, but if any portion of the anterior elastic membrane or the fibrous substance have been destroyed, a cicatrix will always remain to record the fact. When, however, the inflammation of the cornea has been slight, the exuded fluid and cells are absorbed, while the fixed corpuscles assume great nutritive and formative activity, and finally restore the tissues to their former state of integrity; if more severe, many of the fixed corpuscles will have perished, and the leucocytes must participate in the reparative process, and then restoration is not so perfect. If an appreciable portion of tissue have been destroyed, the loss is made up almost entirely by migration cells, new blood-vessels being developed to supply the nutrient material. This process is known as 'granulation' and 'cicatrisation.' By it perfect restoration to the normal state never takes place, the site being ever afterwards indicated by an opacity, which consists of scar-tissue. As the reparative process approaches completion, the new vessels gradually shrink, and ultimately disappear. See *Opacities of the Cornea*, under CORNEA, Ulceration of the.

Causes.—The causes of keratitis are twofold, namely, predisposing and exciting.

The *predisposing* causes may be (*a*) general, or (*b*) local.

The chief general predisposing causes are—age, diathesis, occupation. *Phlyctenular keratitis* (q. v.) occurs most frequently between the ages of three and fifteen years; *interstitial keratitis* (q. v.) between eight years and twenty; whereas *keratitis punctata* (q. v.) is most frequent between the ages of seventeen and thirty. Diathesis plays an important part in keratitis. Scrofula and syphilis each notoriously determines a peculiar form of keratitis, and there is reason to believe that the arthritic diathesis, gonorrhœa, and toxæmic states may be the predisposing conditions of inflammation of the lining membrane of the anterior chamber—keratitis punctata.

Among the local predisposing causes are acute or chronic congestions or inflammations of the conjunctiva; impaired innervation of the eyeball, either from disease of the fifth nerve, or from disorders of the sympathetic, or from dental irritation, or from a tumour encroaching upon the medulla oblongata. Morbid states of associated and correlated tissues may also predispose to keratitis. In inflammation of the ciliary body, for example, the quality of the aqueous humour is altered, and the nutrition of the cornea is, in consequence, prejudicially affected, and the resistance of the tissue thereby diminished. The vascular engorgement of the front portions of the eyeball, which is associated with uncorrected or miscorrected errors of refraction, may render the cornea susceptible to inflammation from slight exciting causes.

The *exciting* causes are, however, the factors that initiate the characteristic pathological phenomena. These agents are always of the nature of 'irritants,' whether material, chemical, thermal, or organic. Foreign bodies, acids, alkalies, sparks, or infective fluids and particles, such as may occur in purulent conjunctivitis or in the accumulated contents of an obstructed lacrymal sac, or other septic fluids, are the most common exciting causes of keratitis.

Treatment.—The objects to be aimed at are: (1) to relieve pain; (2) to arrest the progress of the inflammation; (3) to promote early and rapid resolution; (4) to prevent complications; and (5), if possible, to obviate recurrence.

Happily, those measures which are calculated to attain any one of these ends may be trusted to reach the others. In all cases the indications suggested by a survey of the various predisposing and exciting causes should be carefully followed. In the beginning of the treatment, not only must actual extraneous substances be removed, but precautions must be taken to protect, as far as practicable, the eyes from irritating influences of every kind. Rest of the eyes is always desirable and often obligatory.

It cannot be too strongly insisted upon that, in the early stages at all events, the treatment must be of a soothing and sedative character. Stimulating applications are contra-indicated until resolution is well advanced, and are then only justifiable if the reparative process seems to flag.

One of the most convenient and efficient remedies for the relief of pain, and for favourably affecting the inflammatory process, is moist warmth, either in the form of vapour or fomentations, simple or medicated. Of the medicated applications, decoction of poppies, or a solution of extract of belladonna (gr. iv.–viij. ad f℥j.), is the most accessible and the best. These should be used every two, three, or four hours, according to the severity of the pain. In the intervals the lids should be kept tied up with a light compress saturated in the fomentation, except when there is much conjunctival or lacrymal secretion. Permanent compresses are unsuited to cases in which there is much secretion.

In addition to these external applications, a solution of atropine (gr. ij.–iv. ad f℥j.), should be dropped inside the lids two or three times a day, or oftener, according to circumstances. The benefits of atropine are manifold. It is anodyne, mydriatic, and antiphlogistic. It has an additional use in putting the muscular tissue of the iris, ciliary body, and choroid at rest. Solutions of eserine or pilocarpine (gr. j.–iv. ad f℥j.) are preferred by many practitioners for superficial corneal ulcerations. According to the writer's experience it is not suitable in the earliest stages; and at any time it is, perhaps, most serviceable when the inflammation is marginal. Eserine, or other myotic, is especially indicated whenever the tension of the eyeball is increased, provided there be no iritis.

If the pain be severe, and more particularly if it be supraorbital, the application of one or two leeches to the inner angle of the orbit or over the malar bone, followed by hot fomentations, will seldom fail to give relief. Local depletion answers best in the early or vascular stages of the inflammation, or at the beginning of exacerbations of an existing inflammation.

As the cornea is always liable to be infected by morbid secretions of the conjunctival or the lacrymal sac, cleanliness and drainage should be ensured. Secretions should not be allowed to collect, and those that are present should, as far as practicable, be rendered innocuous. Antiseptic preparations of some kind may be needed; but care must be exercised in their selection. For instance, solutions of carbolic acid are too irritating, and solutions of permanganate of potash are equally inapplicable on account of their solvent action on the corneal cement. The safest and best preparations are solutions of boracic acid (gr. iij.–viij. ad f℥j.), sulpho-carbolate of soda (gr. v.–x. ad f℥j.), perchloride of mercury (gr. $\frac{1}{16}$–$\frac{1}{10}$ ad f℥j.), sulphate of quinine (gr. iv. ad f℥j.), and iodoform ointment (gr. iij.–x. ad ℥j.).

While it is indisputable that, both for the relief of pain and for completeness of the ultimate recovery, the treatment of keratitis must be pre-eminently local, internal remedies are not to be despised. The drugs most likely to ease pain are croton-chloral hydrate, in three-grain doses every half-hour, with or without small doses of gelsemin; juice of conium, in one-drachm doses every two to four hours; opium, either as compound soap pill or compound ipecacuanha powder. Mild aperients and alteratives are useful adjuvants. A mercurial purge at the beginning of keratitis, especially when this is due to injury, often gives distinct relief, and favours the action of the local remedies. In the diathetic inflammations, appropriate constitutional treatment is of course required. It is, however, well not to be too precipitate in adopting 'a tonic plan of treatment.' This caution applies especially to the employment of ferruginous preparations. Iron almost invariably does harm in the irritation-stage of keratitis, although it may otherwise seem to be indicated by anæmia and general debility.

After the acute symptoms have subsided, and reaction is advanced, the process of repair may often be expedited by the occasional application of mild stimulants, such as the yellow oxide of mercury ointment (gr. iij.–xv. ad ℥j.), powdered calomel, and weak perchloride of mercury lotion. Still later, when cicatrisation has begun, these applications may be advantageously combined with light frictions of the lids over the cornea. Friction (massage) systematically employed certainly promotes the absorption of the inflammatory products, and thereby minimises the subsequent opacity.

Counter-irritation by means of a blister behind the ear, or still better over the temple or forehead, is often beneficial in chronic keratitis; but in acute keratitis its value is, to say the least, equivocal. The same remark applies to setons.

If haziness or opacity remain about the centre of the cornea while the margin becomes clear, an artificial pupil may be made opposite the clear cornea. *See* Iris, Diseases of the; Iridectomy.

Finally, it should be remembered that when once a cornea has been inflamed it is liable to recurrences on slight provocation. Hence, the importance of abstaining from close application of the eyes until repair has had time to become thoroughly established, and for some time after.

Forms of Keratitis.—Inflammation of the cornea has been variously classified. Sometimes the classification is based on the character of the inflammation or the stage of the inflammatory process, or its results, as exudative, infiltrative, suppurative, or ulcerative; sometimes on the appearance of the cornea, whether it be vascular or not; sometimes on the constitutional condition with which the inflammation is associated, as struma, syphilis, rheumatism, &c. In this article it is proposed to classify them according to the relations and affinities disclosed by the study of the embryology and physiology of the cornea. Keratitis may therefore be considered according as it affects—(1) The anterior layer; (2) the proper substance; and (3) the posterior layer.

As, however, the phase of the inflammation has important clinical bearings, it is convenient to consider keratitis in its three principal modes of—I. Infiltration; II. Suppuration; III. Ulceration.

I. Infiltration-keratitis may, in accordance with the above-named principle, be classified as it affects—

1. The anterior layer: (*a*) traumatic; (*b*) trachomatous; (*c*) phlyctenular; (*d*) neuropathic, including herpes of the cornea.

2. The proper substance: (*a*) circumscribed, interstitial, or parenchymatous; and (*b*) diffuse interstitial keratitis.

3. The posterior layer: Keratitis punctata, vel Aquo-capsulitis, vel Iritis serosa.

II. Suppuration or abscess due to (*a*) phlyctenular, purulent, or diphtheritic conjunctivitis; (*b*) variolous or neuropathic keratitis.

III. Ulceration which may be (1) inflammatory or (2) non-inflammatory (neuropathic), each of which may affect the superficial or the deeper layers.

(1) Inflammatory ulcers:

(*a*) Superficial, simple, and irritable, or vascular; (*b*) deep, suppurative, and infective.

(2) Non-inflammatory (neuropathic):

(*a*) Circumscribed, superficial, deep, and crescentic; (*b*) diffuse, or necrotic.

I. INFILTRATION-KERATITIS.

1. Inflammation of the Anterior Layer, viz. the epithelium and elastic membrane.

(*a*) *Traumatic Keratitis.* See *Keratitis* above, and Cornea, Injuries of the.

(*b*) *Trachomatous Keratitis or Pannus.* In trachoma, or true granular lids, in addition to the presence of the characteristic growths in the tarsal portions of the conjunctiva, there is a peculiar affection of the cornea and adjacent conjunctiva called 'pannus.' This consists of infiltration, thickening, and vascularisation of the anterior layers, especially at the upper half or two-thirds. These changes are due partly to the mechanical irritation of the roughened lids, and partly to the infiltration. There is no necessary proportion between the amount of trachoma and the degree of pannus. On the one hand, there may be great roughness of the lids, with but slight pannus; and, on the other hand, the pannus may be extreme, but the affection of the lids slight. Indeed, in some cases, the pannus is an early phenomenon, and is fully established, while the trachomata are still confined to the subepithelial layer of the mucous membrane. In such cases, therefore, the corneal affection would seem to be the result of inoculation rather than of friction.

The amount of thickness and opacity varies: when slight, it is called *pannus tenuis*; if thicker, *pannus crassus*, and if very thick and fleshlike, *pannus sarcomatosus*. Except in very chronic cases only the upper half or two-thirds is hazy and vascular, while the lower portion may be unaltered, so that the sight may continue acute, though weak. In severe cases, the swelling, opacity, and vascularity are so great as to give to the cornea the appearance of fleshy granulations, and may implicate its whole extent. A rich network of blood-vessels extends on to the cornea from the conjunctiva and episcleral capsule over the surface. Under these circumstances the subjective symptoms are more marked. Lacrymation, photophobia, and supraorbital pain are present in proportion to the degree of corneal implication. In those instances where ulceration or suppuration of the cornea occurs, these symptoms are very severe.

The infiltration takes place between the epithelium and the anterior elastic layer, and may lead to thinning of this layer and its ultimate destruction. Pannus may be complicated by ulceration of the cornea and perforation, or the inflammation may extend to the deeper structures, and set up iritis, and even panophthalmitis. But short of this retrogressive changes of the cornea may take place, leading to bulging of the cornea and staphlyloma, or the whole of the cornea may become opaque from cicatrisation, followed by flattening and atrophy. In rare cases the pannus undergoes progressive hypertrophy, so as to form permanent growths, which may be mistaken for actual tumours. Glaucoma is a not unfrequent late complication of eyes damaged by trachomatous keratitis.

Diagnosis is usually easy. The keratitis is at first limited to the upper part of the cornea, and an eversion of the upper lid discovers the presence of trachomata. There is, in addition, slight ptosis, with some thickening and incurvation of the upper lid.

Treatment must be chiefly directed to the trachomatous conjunctivitis, though the cornea itself may require special attention. It may, however, be pointed out that corneal implication is not a contra-indication for the active treatment of the trachomatous state of the conjunctiva. On the contrary, it usually denotes that more vigorous measures are needed. For the details of the various modes of treating pannus, see *Trachomatous Keratitis.*

(*c*) *Phlyctenular Keratitis*—This is the most frequent of all the forms of inflammation of the cornea. It is characterised by the presence of one or more minute vesicles, or vesiculo-pustules, situated on the surface of the cornea, or at the corneal margin. When the phlycten is in the cornea, there is always more or less injection of the conjunctival or epithelial vessels; but when at the margin the congestion is limited and patchy, and generally disposed triangularly with the apex towards the phlyctenule and the base towards the conjunctival *cul-de-sac.* The epithelium is rapidly shed, giving rise to a superficial ulcer, which, as a rule, soon heals. Associated with the phlyctenulæ on the cornea there is generally eczema with abortive vesicles on the lids, about the anterior nares, lips, and ears. The subjective symptoms are lacrymation, photophobia, and spasmodic closure of the lids—blepharospasm.

There are three other clinical forms, namely, (1) the miliary, (2) the pustular, and (3) the diffused.

In the miliary form the phlyctenulæ are not discrete, but are scattered around the entire circumference of the cornea. There is more circumcorneal injection; indeed, the general redness of the front of the eyeball resembles that of catarrhal conjunctivitis.

In the pustular form the phlyctenulæ are larger, and usually form around the corneal margin. Necrosis often takes place, resulting in a deep ulcer, which creeps over the cornea, eating its way into its substance, down to the posterior elastic membrane.

In the diffused form phlyctenulæ occur from time to time on the surface of the cornea, leading to general haziness and a vascular condition resembling trachomatous pannus. The anterior elastic membrane is always more or less involved, so that repair is always attended with more or less cicatrisation, though often the scar is not enough to permanently interfere with vision. When repair is retarded the ulcer resulting from the ruptured phlyctenule may become vascular, and partake of the characters of the ordinary irritable ulcer. See *Superficial Vascular Ulcer*, under CORNEA, Ulceration of the. Owing to depraved states of health, the inflammation may be of a low type, and go on to suppuration of the parenchyma and the formation of abscess, followed by ulceration and perforation.

Phlyctenular keratitis is prone to return, and recurrences may be induced by slight causes, as errors of diet, temporary illness, close work, foreign bodies, &c.

Pathology.—The essential anatomical condition of a vesicle in the skin is stratified epidermis. This fact explains the site and distribution of corneal phlyctenulæ. These only occur on, or near, the cornea, and it is noteworthy that only on the cornea and adjacent portions of the conjunctiva the epithelium is stratified. In the rest of the conjunctiva the epithelium is columnar, in which neither vesicles nor pustules form. There are pathological and clinical reasons for believing that a phlyctenula always occurs at a nerve-terminal; this accounts for the photophobia which seems to depend upon the exposure of nerve-terminals.

Causes.—The disease is usually one of childhood, being most common between the ages of two and fifteen years, and it is generally associated with a scrofulous or lymphatic habit of the body, in which cutaneous disorders of an eczematous type are common. It may be provoked by any depraved condition of health, and is set up by an attack of measles, scarlet fever, or whooping cough. In subjects otherwise predisposed, the disease may be early induced by irritants of every kind—wind, dust, foreign bodies, conjunctivitis, &c., and in some cases it seems to be due to reflex irritation, both dental and gastro-intestinal.

Treatment varies somewhat according to the stage. Locally, in the acute stages, warm applications, moist or dry, simple or medicated, with mild antiseptic and detergent lotions, especially when there is eczema of the lids, with copious lacrymation. In the later stages, when vascularity is established, mild irritants are beneficial. When there is reason to suspect septic influences are at work, either the perchloride of mercury lotion, quinine lotion, or chlorine water should be used; for photophobia, cold douches, chloroform vapour, alkaline lotions containing hydrocyanic acid. Blepharospasm usually subsides as the state of the cornea improves, but sometimes it also is perpetuated by fissures at the outer canthus. These may be relieved by forcible separation of the lids, so as to tear the fissure, or by a division of the canthus. In the pustular form, when ulceration begins, eserine is useful to diminish tension, and thereby lessen the risks of perforation. But, if in spite of this, perforation becomes imminent, then the base of the ulcer should be incised, and the aqueous allowed to escape. The eczematous condition of the lids, &c., require appropriate treatment. *See* Eczema. There is almost always at the beginning much constitutional disturbance; alteratives and mild aperients are then useful, as small doses of mercury and chalk powder, with belladonna or compound rhubarb powder, magnesia, &c. In acute cases, where the photophobia is very distressing, nauseating doses of antimonial wine give quick relief to the more urgent symptoms. When the irritative symptoms have subsided, tonics may be employed, as quinine, iron, cod-liver oil, arsenic, phosphorus, hypo-phosphites, &c.

(*d*) *Neuropathic Keratitis.*—It is well known that in injury and other irritative affections of the cutaneous nerves, inflammation and ulceration of the skin supplied by these nerves are not uncommon. Erythema, urticaria, herpes, pemphigus, and eczema are the commonest forms which these nutrition-changes in the skin assume. They are characterised by suddenness of onset, and by a tendency, either spontaneous or easily induced, to suppurate and ulcerate. In some cases the ulceration is so rapid and so extensive that it amounts to necrosis of a material portion of the skin. An illustration of this is seen in the sacral eschars which occur in some acute diseases of the brain and spinal cord. Similar lesions may take place in the cornea in irritative disorders of the fifth nerve and its ganglion. Magendie first showed that division of the fifth nerve may be followed by inflammation of the cornea, with exudation into the interior of the globe. The experiment has been repeated and varied by many subsequent observers with similar results. Clinical experience harmonises with the facts of experimental physiology. The investigations of Bärensprung and others have shown that herpes zoster is associated with irritative change in an intercostal nerve and its ganglion; and in 1866 Mr. Jonathan Hutchinson recorded several cases of frontal herpes in which there was inflammation of the conjunctiva, cornea, or iris of the corresponding eye. In some of the cases the inflammation was so great that the eyes were lost (*Ophth. Hosp. Rep.*, vol. v. 191).

Whatever may be the alteration in the nerve and its ganglion which gives rise to the changes in the cornea, it is almost certain that it is of an irritative rather than of a paralytic character. It is difficult to map out the chief clinical forms of neuropathic keratitis, because they are all prone to run on to suppuration and ulceration. Indeed, with the exception of herpes of the cornea, it may be said that neuropathic keratitis is almost invariably ulcerative. In the writer's opinion there is reason to believe that inflammation of the cornea dependent on neuropathic causes is much more frequent than is commonly supposed. It is usual to recognise as neuropathic only those forms of keratitis that are associated with other and obvious affections of the fifth nerve, such as herpes of the brow and nose, together with anæsthesia of these parts and the cornea. On the other hand, it is probable that many cases occur in practice in which the affection of the eyeball is the *only obvious* evidence of altered innervation. At all events, it is certain that cases are by no means infrequent in which the inflammation of the cornea behaves exactly like unquestionable neuropathic keratitis, and which is amenable only to the kind of treatment that best suits the genuine form.

The state of sensitivity of the cornea does, however, seem to influence the kind of change which takes place and the rate of progress. If the cornea be anæsthetic, suppuration and ulceration often take place with extreme rapidity, though without any subjective symptoms beyond the loss of vision. Within a few days of the first appearance of noticeable symptoms the cornea may be completely destroyed. In less severe cases the cornea becomes dull and sodden-looking on its surface, the substance is more or less infiltrated, and there is, perhaps, a small collection of pus in the anterior chamber. If the necrotic process continue, all these signs increase, and the cornea may at length give way. When the cornea is not insensitive the rate of progress is slower, but the pain, photophobia, and other subjective symptoms are greater. In this form the signs of inflammation are also more conspicuous, as redness, watering, and swelling of the lids and conjunctiva. In some cases it would almost seem as if the ordinary pain of ulceration of the cornea had superadded to it the exaggerated, but perverted, sensibility of the diseased nerve.

In some instances the corneal change is more circumscribed, and may simulate simple phlyctenular keratitis. A minute, very superficial, abscess forms, which quickly opens externally to form an ulcer: but, instead of healing, the ulcer becomes more and more infiltrated, and increases both in extent and depth. See *Neuropathic Ulcers*, under Cornea, Ulceration of the.

The change in the cornea may be modified by the condition of the lids and conjunctiva. A certain amount of conjunctivitis always accompanies neuropathic keratitis; if the secretion is purulent, or if it be allowed to become septic, it may aggravate the corneal trouble. The position of the lids also influences the course of the inflammation; if there be ptosis, from paralysis of the elevator of the upper lid, the nutrition-changes in the cornea will probably be very slight; but if, on the other hand, there be paralysis of the orbicularis, then the destructive changes in the cornea will progress with great rapidity, if care be not taken to close the lids and keep them closed.

Treatment.—Protection of the eye is an indispensable precedent to the success of every other measure. In the majority of cases repair will speedily take place if the lids be closed, and the fluid contents of the conjunctival and lacrymal sacs be kept free from decomposition and other septic deterioration. In mild cases it may be enough to close the lids by means of a well-fitting compress, smeared with lard, vaseline, or, preferably, with boracic acid ointment (gr. xx. ad ℥j.). If, however, the ulceration refuse to heal with simple closure of the lids, then a more effectual exclusion may be secured by paring the edges of the upper and lower lids, and stitching them together, except at the outer and inner canthi, and a small space in the centre of the palpebral fissure. In this way all foreign particles are excluded, at the same time that the secretions of the conjunctiva have a ready exit at the inner canthus. Even when the edges of the lids are stitched, a light boracic acid compress should be worn, and the conjunctival sac should be washed out once or twice a day with boracic acid or quinine lotion. The lids should be kept closed for some weeks after the cornea is healed and all pain or discomfort has subsided.

If there be iritis, atropine should also be applied two or three times a day; and if the pain be great, a hot belladonna compress may be substituted for the boracic acid one.

Herpes of the Cornea.—Arguing from analogy, this is a neuropathic affection, and is indeed sometimes associated with herpes frontalis. Whether accompanied or not by the appearance of vesicles in the area supplied by the ophthalmic division of the fifth nerve, it usually begins with neuralgic pain about the brow and side of the nose, and may be accompanied by pyrexial symptoms—headache and vomiting. Minute vesicles appear on the cornea, disposed in groups or linearly, and raising the epithelium. At first the contents are clear and transparent, but in the course of twenty-four hours they abound in leucocytes. When the vesicles appear, the pain generally subsides. In a few days the vesiculo-pustules burst, giving rise to minute superficial ulcers, which may soon heal without leaving any scar behind. The subjective symptoms are photophobia and lacrymation. In some cases the ulceration spreads both in extent and depth, and may end in destruction of the cornea. The disease usually only affects one eye at a time; but it is liable to recurrence, and then the opposite eye may be affected. *See* Eyelids, Diseases of the; Herpes Frontalis.

Treatment.—Protection of the eye by closure of the lids, either with a belladonna compress or a simple compress of boracic acid ointment. Atropine may be put in once or twice a day, to relieve the pain. Internally, quinine, phosphorus, or arsenic, separately or suitably combined.

2. Inflammation of the Proper Substance of the Cornea.—This occurs in two forms—(*a*) circumscribed, (*b*) diffuse. In both there is migration of leucocytes into the stroma of the cornea; and in both there is but little tendency in the inflammation to go on to suppuration or ulceration.

(*a*) *Circumscribed interstitial keratitis.* Compared with the diffused form of interstitial keratitis to be described below, this is rare. It does, however, occur sufficiently often to merit notice. It shows itself as dense circumscribed infiltration of the substance of the cornea, usually associated with considerable inflammation of the sclerotic, the iris, and the ciliary body. There is great ciliary injection, together with other signs of irido-cyclitis. The infiltrations may occupy any portion of the area of the cornea, though they are generally more pronounced towards the margin, in which case they resemble invasions of the sclerotica into the cornea. Hence the name *Sclerosing keratitis* which has been given to the disease. The corneal epithelium remains smooth, and the infiltrations rarely suppurate or ulcerate. The tension of the eyeball is subnormal, and, in all the cases which have come under the writer's notice, the lids have been considerably discoloured; but in all the discolouration has disappeared as the inflammation of the anterior segment of the eyeball subsided. Subjectively, the disease manifests itself by impairment of sight, photophobia, lacrymation, and general weakness of the eyes. After some weeks or months the infiltrations gradually disappear, though more or less opacity permanently remains.

Causes.—The etiology of the disease has not yet been elucidated. The disease generally occurs in adults, and is sometimes associated with chronic rheumatism. There is no evidence to show that it is connected with syphilis. It is perhaps more common in women than in men.

Treatment.—The disease is chronic, and the treatment must be conducted on the lines laid down in the directions for dealing with keratitis in general. It should, however, be remembered that the disease is not limited to the cornea, but involves the whole of the anterior segment of the globe, including sclera, iris, and ciliary body. The treatment of inflammation of these parts must therefore be combined with that more particularly suited to keratitis. *See* CILIARY BODY; IRIS. Besides the use of fomentations, leeches, atropine, counter-irritation, protection of the eyes, &c., it may be necessary to resort to the operation of iridectomy (q. v.). As regards general treatment, quinine, salicylate of soda, and hypodermic injections of pilocarpine have been extolled. The writer has found Donovan's solution very beneficial in doses increasing (at discretion) from five to fifteen minims three times a day.

(*b*) *Diffuse interstitial keratitis* passes through three well-defined stages—(1) infiltration, (2) vascularisation, (3) resolution. In the *first stage* the cornea becomes more or less hazy, usually beginning at the centre, but gradually invading the whole extent. In addition to the general haze, minute milky-looking dots, resembling 'microscopic masses of fog,' are scattered throughout the substance. In the course of two or three weeks the haziness increases, and the cornea becomes quite opaque. The epithelium at first is unaffected, but it soon becomes steamy, giving, with the opacity of the cornea, the appearance of ground-glass. The subjective symptoms, beyond the progressive impairment of sight, are, as a rule, but slight. Little is complained of beyond a weakness and watering of the eyes. After three to six weeks the *second stage* is ushered in. The perikeratic injection, hitherto slight, becomes more pronounced, and new vessels are seen extending into the substance of the cornea, from the sclerotic and conjunctiva. These vessels may at length become so numerous that the cornea resembles a patch of ecchymosed blood. Usually the vascularisation is not so great, and the cornea is of a pink hue, not unlike the flesh of salmon. Unless the natural history of the disease be known, the advent of this vascular stage is likely to create alarm. The surgeon is distressed to witness the disease apparently progressing in spite of his best endeavours to stay its course. The truth is, however, far otherwise. The formation of new vessels is to be welcomed, not only as affording present safety of the cornea, but as an indispensable condition of ultimate repair. The infiltration is sometimes so great that it breaks through the superficial layers of the cornea and projects from the surface like exuberant granulations. Even when this happens, the hope of recovering useful vision is not to be abandoned. The cornea may eventually clear sufficiently to allow of moderate sight, though a central leucoma may persist. The vascular stage lasts from three to six months, and is followed by the *third stage* of resolution. The discolouration of the cornea begins to fade; the vessels become smaller and less numerous; semitransparent spaces appear between individual vessels, and gradually the vessels shrink towards the margin, till at length they entirely disappear. In the course of three to twelve months the cornea may recover its normal translucency, or retain only a nebulous haze about the centre. Usually, however, the cornea remains more or less hazy throughout its whole extent, with deeper haze about the centre, which prevents perfect acuteness of the sight. Leucomatous opacity does not occur, except in the comparatively rare event of ulceration.

In most cases the iris and choroid are implicated. Iritis and choroiditis seriously complicate the corneal affection. Unless the possibility of their occurrence be kept persistently in mind, the inflamed iris may contract adhesions to the anterior capsule of the lens, with total posterior synechia and obliteration of the pupil. This in turn may lead to inflammation of the ciliary body (cyclitis), of the choroid, or of the vitreous. During the vascular stage the cornea may become so soft that it yields to the intraocular pressure, and a staphyloma results.

The disease usually affects both eyes, though it generally begins in one eye a few weeks, or may be months, before the other. Indeed the second eye sometimes does not show any symptoms till the disease has reached the third stage in the eye primarily affected.

Causes.—Interstitial keratitis is dependent on constitutional causes, though the exciting cause may be an injury. It generally makes its appearance during childhood or adolescence, between the ages of five years and twenty years. Almost invariably it may be shown to be associated with hereditary syphilis, and in most cases positive or circumstantial evidence of this taint may be obtained either from the history of one or both parents, or from the presence of syphilitic lesions in the patient, as nodes, ulceration of the throat, &c. In many cases there is a peculiar and characteristic physiognomy, exhibiting prominent frontal eminences, depressed bridge of the nose, fissures about the angles of the mouth, nose, and forehead, together with a remarkable configuration of the permanent central incisor teeth, which are peg-shaped and notched at their edges. In less typical cases the shape of the teeth resembles that of a screw-driver.

Treatment.—The cyclical character and constitutional nature of the disease must be borne in mind. As far as present knowledge and the resources of therapeutics go, the disease must run its course and pass through its three stages. All that the practitioner may hope to do, is to guide the disease through its various stages, and to obviate complications. The first indication is therefore to alleviate actual pain and to control the local inflammation; the second to expedite and shorten the various stages, remembering always, other things being equal, the shorter the course of inflammation the more complete the recovery. Whatever may be the stage, protection from all irritating agents and influences is indispensable, but particularly in the vascular stage. The treatment must be of a soothing and mildly antiphlogistic character. In the first stage, moist warmth by means of steam, or fomentation either of hot water or of belladonna, gives relief, especially when combined with the instillation of atropine. Care should be taken to protect the eyes by means of spectacles or shades, and astringents and other stimulating applications should be avoided. Atropine should be used, whether the iris be obviously inflamed or not, and the precaution should be taken not to stop its employment because the iris ceases to be visible through the opaque cornea. If there be much supraorbital pain, the application of one or two leeches will give relief. If the iritis be severe and obstinate, especially if the ciliary body be likewise implicated, some practitioners resort at once to iridectomy. The prudence of the practice is, however, debateable. The operation should be reserved for those cases in which the irido-cyclitis is accompanied by persistent, increased hardness of the globe, which does not yield to atropine and hot fomentations. The general treatment must have reference to the constitutional condition on which the keratitis depends, namely hereditary syphilis. *See* CONGENITAL SYPHILIS.

3. INFLAMMATION OF THE POSTERIOR LAYER OF THE CORNEA.—The posterior layer of the cornea, consisting of the posterior elastic membrane (Descemet's) and endothelium, is subject to a special form of inflammation. There are anatomical, embryological and morphological reasons for believing this layer to be directly continuous with the choroid. This connexion is likewise indicated in morbid states. Inflammation of the posterior layer of the cornea is always associated with inflammation of the anterior layers of the iris, and probably also of the choroid. Hence the various names which have been applied to this disease, namely, keratitis punctata, serous iritis, aquo-capsulitis, and inflammation of the lining membrane of the anterior chamber. The disease was first described by Wardrop, under the last-mentioned name, about the beginning of the present century. He pointed out that the lining membrane of the anterior chamber has the characters of a serous membrane, and that inflammation of it resembles inflammation of the other serous membranes of the body. The symptoms which he described as characterising the disease were haziness of the posterior layer of the cornea, and deposition of lymph. This deposition usually takes the form of brownish dots, arranged as a pyramid with the apex upwards. The anterior chamber is deep, the aqueous slightly turbid, the anterior surface of the

iris loses some of its lustre, though the fibrillation remains, and the pupil is semi-dilated. The injection round the cornea is slight and of a delicate pink hue, and often the eyeball is harder than natural. The iris is pushed somewhat backward by the dropsy of the anterior chamber, and, instead of being convex forwards, it is concave. There is total posterior synechia, though the amount of lymph is comparatively small. The pupil does not respond readily to atropine, partly because of the adhesion, and partly in consequence of the increased accumulation of fluid contents within the eye.

Beyond dimness of sight, the subjective symptoms of keratitis punctata are not as a rule very marked. Wardrop called special attention to the subjective sensation of distension and fulness in the eyeball, accompanied by a dull aching pain in the forehead, sometimes also at the back of the head, all of which symptoms are, he said, 'instantly and permanently relieved by evacuating the aqueous humour.'

Causes.—The associated constitutional state is variable, but is generally of that order in which the serous membranes are affected. Rheumatism (simple or gonorrhœal), syphilis, disordered menstrual functions, renal disease, and other toxæmic and septicæmic conditions, predispose to it. In some instances no predisposing cause can be discovered. The writer has so often met with keratitis punctata as the precursor of ordinary interstitial keratitis that he is disposed to believe that, in some degree, it precedes all such cases. In actual practice, however, cases of interstitial keratitis are rarely seen by the ophthalmic surgeon before the parenchyma of the cornea is involved. Keratitis punctata is also one of the earliest objective signs of Sympathetic Opthalmitis (q.v.).

Treatment.—The local treatment varies somewhat, according to the state of eyeball-tension. If the eyeball be distinctly hard, and if the hardness do not at once respond to atropine, the cornea may be punctured. This is often followed by speedy relief to pain and rapid subsidence of the inflammation. The hardness of the eyeball might seem to contraindicate the use of atropine, and point rather to the employment of eserine; but it should not be forgotten that the conditions of keratitis punctata are different from those of acute glaucoma, where eserine is indicated. In the former there is a dropsy of the anterior chamber; in the latter the anterior chamber is shallow, and may be obliterated. In keratitis punctata a mydriatic is needed to break down the adhesion of the iris to the capsule of the lens, and to restore the communication between the anterior and posterior chambers. If this be accomplished, the hardness quickly disappears. If there be much pain, leeches may be applied either at the inner or outer angle of the orbit, followed by hot fomentations. Of all internal remedies, the writer is disposed to regard turpentine as the most useful. This drug was originally recommended by Carmichael, of Dublin, for syphilitic iritis, on account of its acknowledged influence in some inflammations of the general serous membranes and especially in peritonitis. He gave it in one-drachm doses; but Chian turpentine in five-grain doses, every three, four, or six hours, is less disagreeable, though it is not quite so active. Cases in which turpentine is administered early seem not only to recover more quickly, but with less permanent damage, than those in which other modes of treatment have been tried. This is particularly true of the gonorrhœal form. Next to Chian turpentine is the employment of mercury in small but repeated doses, especially combined with quinine: from one to two grains of the latter, with one-sixth to one-third of calomel, three times a day. Subcutaneous injections of pilocarpine have been recommended, and are said to have been followed with considerable benefit. After the acute symptoms have subsided, then tonics: iron, quinine, arsenic, phosphorus, with cod-liver oil. *See also* Iris, Diseases of the.

II. Suppurative Keratitis.—Abscess of the cornea may complicate ordinary phlyctenular ophthalmia, but more commonly it is due to traumatic or infective causes operating in debilitated states of the health. It is a common complication of purulent and of diphtheritic conjunctivitis, and is especially prone to occur after smallpox or from slight injuries in persons suffering from chronic conjunctivitis, or who have catarrh and obstruction of the lacrymal sac and duct. Suppuration of the cornea may also be due to an impaired innervation, associated with disorders of the fifth nerve. *See above—Neuropathic Keratitis.*

An abscess being a more or less circumscribed collection of pus within the corneal substance, the fibrillæ are necessarily destroyed, and repair can only take place by cicatrisation. An abscess may form in any part of the depth of the cornea, and may begin at one or several spots. When it begins at several foci, each grows in size till they all run together to form a common collection of pus. Around this collection there is always more or less infiltration of the layers of the cornea. The shape is usually circular, but may be crescentic. If a crescentic abscess form at the lower part of the cornea, it is called by the special name *Onyx*.

Abscess in the superficial layers of the cornea may undergo gradual absorption without opening externally; but when more deeply situated, softening and destruction of the superficial layers take place, and the contents of the abscess escape on the surface with the formation of a deep ulcer. *See* CORNEA, Ulceration of the. Rarely, the abscess opens into the anterior chamber through the posterior layer, forming *hypopyon*; indeed, abscess of the cornea is usually attended with more or less pus in the anterior chamber. The pus in hypopyon may be derived from one or more of four sources:—(*a*) Actual perforation of the ulcer through the posterior layer; or (*b*) infiltration through the corneal canals into the lymphatic spaces at the angle of the anterior chamber; or (*c*) proliferation of the corneal endothelium; or (*d*) by transmigration of leucocytes from the iris and the ciliary body.

Hypopyon, though resembling onyx, may readily be distinguished from it. In hypopyon, the pus in the anterior chamber being free to move, gravitates to the most dependent part of the anterior chamber when the head is inclined; whilst in onyx, the pus, being confined within the lamellæ, cannot change its place.

Perforation of the cornea with entanglement of the iris, or cataract, or even escape of the lens, may supervene as a complication of abscess of the cornea. A peculiar opacity at the anterior pole of the lens is a not uncommon result of suppuration of the cornea in ophthalmia neonatorum. *See* CATARACT.

Treatment.—Abscess of the cornea is not only a painful affection, but it always places the cornea in the greatest jeopardy. It is also an indication of debility, or of impaired innervation, or of local septic influence. Moist warmth, combined with atropine or belladonna, gives relief and promotes the absorption of pus. The effect of atropine should, however, be carefully watched. If the eyeball becomes hard under its employment it should be discontinued, and the cornea should be punctured through the abscess, especially when perforation is imminent. Where there is reason to believe that the pressure of the lid (as in purulent ophthalmia) may be promoting suppuration of the cornea, the lid should be freely cut through vertically and towards the other canthus. This not only removes the pressure, but facilitates the application of remedies. See also *Purulent Ophthalmia*, under CONJUNCTIVA, Diseases of the.

As abscess of the cornea is usually septic, and as, at all events, when disruption of the external layers of the cornea has taken place, infection is liable to take place, antiseptic agents should be used as local applications. Of these, solution of sulphate of quinine is one of the best, for, unlike many other antiseptic agents, it is also antiphlogistic. It helps to arrest the inflammatory process and check the migration of leucocytes. Precautions should be taken against the infection of the cornea with the decomposing contents of the lacrymal sac; any accumulation in the sac should be removed and free drainage ensured.

The treatment of hypopyon may vary with the character of the pus. If this be serous and scanty it will probably soon disappear under the influence of hot belladonna fomentations; but if it be copious and tenacious, section of the cornea must be done across the base of the ulcer, after the plan proposed by Saemisch, in order to evacuate the contents of the anterior chamber. The incision should be made with a sharp and clean Graefe's knife, and a section made by transfixion freely through the whole thickness of the cornea at the seat of abscess, so that the pus may have a free exit. If the hypopyon re-form, it will be necessary to reopen the incision, either by means of a fine probe or by a fresh incision. The drawback to the procedure is entanglement of the iris in the wound. Something may be done to avert this by using atropine or eserine freely, according to the situation of the section and the state of the iris. If the section be near the centre of the cornea, then atropine is indicated, to draw the iris away; if more towards the periphery, then eserine, to contract the pupil and prevent prolapse of the iris into the wound.

Abscess of the cornea is debilitating in its effect, and usually dependent on depraved states of the general health; generous diet and tonics, especially quinine, will therefore be required, in addition to local treatment. JOHN TWEEDY.

CORNEA, Ulceration of the.—The usual antecedent of ulceration is inflammation. In suppuration of the substance of an organ, the tissue-elements are disintegrated by the action of the inflammatory fluids and leucocytes, and a cavity forms which is filled with pus-cells (abscess). The same process occurring on the surface of an organ leads to the formation of a chasm, or ulcer.

It is in this way that most of the ulcers of the cornea are produced, the degree of ulceration being proportionate to the amount and kind of the inflammation. There are, however, other ulcers in which inflammation is either altogether absent, or, if present, is so slight that it cannot account for the degree of ulceration. The probable cause of the latter kind is that the nutrition of the tissue-elements is deteriorated by disturbed innervation. This explanation is fortified by the fact, that such ulcers do resemble those which are associated with appreciable disease of the ophthalmic division of the fifth nerve, and behave in a precisely similar manner.

Ulcers of the cornea may therefore be classified as :—1. Inflammatory; 2. Non-inflammatory (neuropathic). They may be described in the same terms as those of the skin, and like them may be spoken of as spreading, stationary, or healing. In each of these phases the constituent parts of a corneal ulcer present the aspects of corresponding phases of cutaneous ulcers. In spreading ulcers the form is irregular, the edges are elevated, jagged, or sharp-cut, the base is covered with débris, and the adjacent parts are infiltrated with serum and leucocytes. The lamellæ are broken and bend towards the surface. When repair begins, the surrounding infiltration disappears, the base clears, the edges smooth down, new vessels extend from the periphery to the floor of the ulcer, the epithelium gradually encroaches upon it, and at length the breach is filled by cicatricial tissue, never by proper corneal substance.

In ulcer of the cornea there are present most of the objective signs of keratitis, such as redness of the conjunctiva, circumcorneal or ciliary injection, and lacrymation, blepharospasm, &c. The subjective symptoms are pain in the eyeball and around the orbit, and photophobia. These symptoms vary with the degree of inflammation and with the position of the ulcer.

1. Inflammatory Ulcers may be classified as they affect (*a*) the surface of the cornea, or (*b*) the deeper layers.

(*a*) *Superficial Inflammatory Ulcer* presents itself clinically in two forms—namely, the simple and the vascular or irritable.

(1) *Simple ulcer* usually follows the bursting of the pustule in phlyctenular ophthalmia, but may result from any inflammation of the superficial layer of the cornea. A small greyish patch is seen on the cornea, with congestion of the nearest conjunctival and sclerotic vessels. The amount of congestion varies, however, with the degree of inflammation, and with the site of the ulcer. In most cases, if the eye be protected the ulcer soon heals, and its place is marked by a thin scar (nebula). But if the ulcer be irritated, either by topical remedies, or by decomposing secretions of the conjunctival or lacrymal sac or other septic agents, or if it should occur in debilitated persons, or in a cornea damaged by previous inflammation, it may spread into the deeper layers and become the so-called *Deep Inflammatory Ulcer* (q.v.)

Treatment, in the acute stages, is the same as that recommended in phlyctenular keratitis; in the later stages mild stimulation to the ulcer.

(2) *Irritable Vascular Ulcer.*—Sometimes, either from the conditions of health or from inappropriate treatment, the phlyctenular ulcer, instead of undergoing repair, remains vascular, and the granulation tissue fails to undergo cicatrisation. One or two large vessels may be seen extending from the margin of the cornea to the base of the ulcer, which is itself covered by a network of fine vessels. When touched with a probe these ulcers are exquisitely tender; the morbid sensibility in all probability depending upon the presence of exposed and inflamed nerve-terminals. Such ulcers are usually situated just within the margin, but may occur on any part of the surface. They are intensely painful, and are always attended with distressing photophobia and profuse lacrymation. In some cases the pain is so great that it prevents sleep, destroys the appetite, and seriously affects the general health.

Treatment.—Where there is reason to believe that the vascularity of the ulcer is the result of over-stimulation, all that may be needed to ensure recovery is discontinuance of local applications. Should this not suffice, then the application of a solution of nitrate of silver (gr. x.-xx. ad f℥j.), or even the careful application of the mitigated stick of nitrate of silver, destroys the diseased surface and quickly relieves the pain and initiates healthy repair. This treatment is safe, provided the cases are properly discriminated, and is certainly more effectual than the painful and tedious plan of inserting setons into the temple or of applying other forms of counter-irritation.

(*b*) *Deep Inflammatory Ulcers.*—These may be the result of extension of superficial ulcers, or of the opening of an abscess or of an infecting traumatism. Of these deep ulcers it may be stated generally that, unless complicated by iritis, hypopyon, &c. they are not, as a rule, so painful as superficial ulcers, and, conversely, that when a superficial ulcer spreads to the deeper layers the pain often abates. The explanation of these facts is to be found in the distribution and termination of the corneal nerves.

(1) *Suppurative Ulcer.*—In this ulcer the objective signs of keratitis are necessarily always present, and usually most of the subjective symptoms also. It is, however, noteworthy that a deep ulcer, following abscess of the cornea, may be attended with very little pain or irritation. If the corneal affection be complicated with iritis or iridocyclitis, there may be very great pain over the eyebrow and at the root of the nose. The ulcer itself has a sloughy base, and the adjacent portions of the cornea are infiltrated. The anterior chamber is at first usually deep, and may contain more or less pus. The ulceration comprises the deeper layers, and as these give way, a hernia of the posterior elastic lamina (keratocele) occurs, followed after a short interval by rupture with prolapse and entanglement of the iris, so that when it is healed there is a dense opacity of the cornea called 'leucoma,' with an anterior synechia—*leucoma adherens.*

This kind of ulcer is often traumatic, but may apparently occur spontaneously in eyes that have been damaged by previous inflammation, whether phlyctenular or trachomatous. It is, however, frequently met with in connexion with purulent and diphtheritic conjunctivitis, and is then due to the inoculation of the cornea with specific virus. Old age and impaired states of health, from any cause whatever, predispose the cornea to suppurate and ulcerate on comparatively slight excitation.

Treatment.—The indications are: protection and cleanliness, drainage of all secretions, disinfection of the conjunctival and lacrymal sacs by means of antiseptic solutions, moist warmth, either simple or medicated, to allay the inflammation and to relieve pain. If the intraocular tension increases, eserine should be used; and if perforation become imminent, paracentesis of the cornea; or section, after the plan recommended by Saemisch, should be done. When much hypopyon appears, section of the cornea through the ulcer should be performed. If prolapse of the iris take place with the formation of a fistula, the prolapsed portion of the iris must be freely excised, and a compress applied, the aperture being left to heal by cicatrisation. In removing a prolapsed iris, the protruding mass should be grasped close to the level of the cornea, and pulled gently out of the perforation, so as to overstretch it. If the iris then be cut it will retract into the anterior chamber, and so obviate further anterior adhesion. During the process of cicatrisation it may be well to keep the iris under the influence of eserine, to prevent further entanglement, as well as to lessen tension. If, in spite of these precautions, a fresh entanglement occur, especially if it be near the corneal margin, an iridectomy should be done at the site of the entanglement. This not only takes away the risk of glaucoma, but lessens that of sympathetic ophthalmitis.

(2) *Infecting Ulcer* is an extremely obstinate and malignant form of ulceration, and generally ends in perforation, with more or less permanent damage to the eye. Whatever may be the primary cause, when once the ulceration has begun it spreads by infection. The edges creep into the cornea, and extend in all directions. The base is greyish, the edges swollen and irregular, the anterior chamber is deep, the aqueous turbid and contains pus, and there is more or less deposit on Descemet's membrane opposite the ulcer. The ulcer may spread so rapidly that in a few days the whole of the cornea is implicated and converted into a slough. Perforation speedily ensues. When this accident happens there is a sudden cessation of pain, due to the relief of pressure consequent on the escape of the contents of the anterior chamber. From that moment repair may begin. But unless the perforation be large, it is liable to become blocked with tenacious pus and shreds of membrane. In this event there is a recurrence of the pain after a few hours or days. Even when repair does begin, it is slow and intermittent, and the reparative material is apt to break down from time to time. At the beginning this ulcer is seldom painful, though the pain increases as the ulceration extends, and often immediately before the perforation, whether spontaneous or by artificial means, the pain is excessive.

Causes.—It may begin spontaneously, but more commonly it is the result of an injury in which the cornea has become inoculated by the septic matter, or by the decomposing secretions of the conjunctiva or lacrymal sac. It is especially common in farm-labourers, who are liable to injuries of the cornea from thorns or from particles of chaff, &c. It seldom occurs before forty years of age, and is usually met with only in debilitated subjects.

Treatment.—It is in this form of ulceration that incisions of the cornea, as recommended by Saemisch, are of such signal service. *See* above. After incision, warm fomentations and the antiseptic application of perchloride of mercury, quinine, &c., should be freely applied to prevent further infection of the exposed corneal layers. Some practitioners recommend that the base of the ulcer should be scraped, and then either strong solutions of nitrate of silver be applied, or even the actual cautery.

2. NON-INFLAMMATORY ULCERS (NEUROPATHIC).—These ulcers all seem to begin primarily on the surface of the cornea, though they may subsequently implicate the deeper layers, and, like the inflammatory deep ulcers, tend to perforation. In the absence of a degree of inflammation sufficient to induce ulceration, the only sufficient cause seems to be arrested or perverted innervation. Hence these non-inflammatory ulcers may be designated neuropathic.

Ulceration of the cornea, associated with altered innervation, may exhibit as many forms as a corresponding lesion in the skin. In most cases there is a preliminary stage of cell-infiltration rapidly running on to suppuration and ulceration; but it may happen in the cornea as in the skin, that the inflammatory stage is so brief or so slight that the ulceration seems to be a primary phenomenon. Neuropathic ulceration seems to begin at the terminations of the nerves, the kind and extent of the ulceration being dependent partly upon the number of terminals involved, and partly upon the character and seat of the central change. This form of ulceration may therefore be either circumscribed or diffuse.

(*a*) *Circumscribed Non-inflammatory Ulcers* present almost numberless varieties. There are, however, certain well-recognised forms:—(1) Superficial non-vascular ulcer; (2) deep non-vascular ulcer; and (3) the crescentic ulcer.

(1) *Superficial Non-vascular Ulcer.*—This is also called 'ulcer by absorption,' or 'facetted ulcer,' or 'superficial transparent ulcer.' It usually appears in the centre, and apparently suddenly. There is slight depression, with smooth, rounded, non-vascular border. When examined by ordinary daylight the ulcer appears transparent and glassy-looking, and may be easily overlooked. There are few symptoms of inflammation, such as pain, photophobia, or lacrymation. Perhaps the only complaint is that the sight is obscured. The ulcer may remain stationary for weeks, or even months, and it is always slow to recover. It occurs most frequently in children who have delicate skins, who are liable to eczematous and impetiginous disorders, and who are subject to phlyctenular keratitis. Indeed it often co-exists with this disease. When it heals it leaves behind it a semi-transparent cicatrix, producing a facetted appearance.

Treatment.—At first, warm fomentations and protection; later, mild stimulation with eserine night and morning; and, when the vascularity occurs, stronger stimulation with weak yellow-ointment, calomel powder, perchloride of mercury, &c. Care should, however, be taken to avoid over-stimulation.

(2) *Deep Non-vascular Ulcer*, called also *Asthenic Deep Ulcer.*—It usually appears suddenly, and generally about the centre of the cornea, thus resembling the superficial non-vascular ulcer. The edges are deep and irregular, and the outline inclines to an oval. The ulcer rapidly increases in depth till it reaches the posterior elastic layer. Hernia of this layer follows, so that the ulcer may not seem so deep as it really is. The ulcer may remain stationary for many months. When repair does take place, the edges become vascular and rounded off; the cavity is gradually filled up by granulation and cicatrisation. As with the superficial ulcer, the cicatrix is semi-transparent, and leaves a facetted appearance. It is distinguished from the superficial non-vascular ulcer by its great tendency to perforate the cornea, by its occurring in adults rather than in children, and in eyes that are damaged by old disease, as phlyctenular keratitis, granular lids, &c. It is usually symmetrical. In the rapidity of this formation, and in many of its other characters, it resembles acute bed-sore, which is apt to occur in some cerebral and spinal affections.

Treatment.—Treatment must be directed towards preventing perforation and facilitating repair; warm fomentations, compresses to the lids, the cautious application of eserine, to lessen tension and to set up a certain degree of stimulation. If the tension be increased, and the cornea threatened with rupture, then paracentesis through the base of the ulcer, or sclerotomy, may be practised. When the ulcer has become vascular, then mildly stimulating applications like those recommended above may be cautiously employed. As there is great risk of this ulcer becoming infected by the secretions of the conjunctiva, or from the decomposing accumulations in the lacrymal sac, care should be taken to disinfect these secretions, and to secure efficient drainage of the lacrymal apparatus. If, in spite of treatment, the ulcer continues to spread, or refuses to heal, then it is well to employ some antiseptic application, such as quinine lotion, or boracic acid, or salicylic acid, and to tie up the eye with a compress of boracic acid ointment (gr. xx. ad ℥j.).

(3) *Crescentic Ulcer*, though rare, is generally recognised as a distinct clinical entity. In its developed state it appears as a deep crescentic or horseshoe-shaped ulcer just within the corneal margin. In the early stage it begins as one or more opaque dots near the corneal margin, accompanied with some congestion of the adjoining conjunctival and episcleral vessels. Necrosis quickly takes place at these dots, and ulcers form. These ulcers lengthen, so that they become first oval and then curvilinear, always running concentrically with the margin of the cornea. At length two or more of these curvilinear ulcers merge and constitute the crescentic ulcer. At first the ulcers are semi-translucent, but they soon become infiltrated with pus-cells. If unchecked the ulceration destroys the deeper layers of the cornea, and ends in perforation and prolapse of the iris. If, however, repair takes place the infiltration disappears, the edges round off, vessels pass inwards, and healing by cicatrisation slowly takes place.

Crescentic ulcers are generally extremely painful, and attended with great photophobia and lacrymation; they usually occur in persons who are suffering from nervous exhaustion, or who manifest other neuropathic states.

Treatment.—Crescentic ulcers resist all modes of treatment so long as the lids are free to open; but, in the writer's experience, they speedily begin to heal if the lids be securely closed, either by means of a well-fitting compress of boracic acid ointment, or, if necessary, by means of paring the edges and stitching them together. The conjunctival sac should be gently cleansed once or twice a day with boracic acid or quinine lotion, and belladonna fomentation may with advantage be employed to the closed lids for ten minutes at a time every two hours. Internally, tonics, especially quinine, phosphorus, small doses of arsenic and cod-liver oil, are beneficial, and in the later stages, iron.

(*b*) *Diffuse ulceration* is the most frequent form of neuropathic disease of the cornea, and occurs most frequently in association with herpes frontalis. There may be but few subjective signs beyond impaired sight; pain, referable to the eye, may be entirely absent, though there may be excessive pain in the eyebrow, forehead, nose, and temple. The whole of the cornea, but particularly the portion opposite the palpebral aperture looks steamy. The epithelium is sodden, roughened, and disintegrated. Still later the cornea becomes infiltrated, and presents in addition numerous foci of collected leucocytes. At length pus appears in the anterior chamber, the whole of the cornea obviously suppurates, and perforation occurs. In most cases there is more or less iritis of a serous character, a deep anterior chamber with perhaps increased intraocular tension.

Opacities of the Cornea.—Apart from the transitory opacities due to inflammation and the opacity associated with changes of curvature described below, as staphyloma, there are other opacities which are more or less persistent. These are (*a*) cicatricial, (*b*) glaucomatous, (*c*) sclerosal, (*d*) degenerative, as calcareous change in the corneal epithelium, arcus senilis, metallic deposits and stainings.

(*a*) *Cicatricial Opacities* are called 'nebulæ' or 'leucomata,' according to their density. They are the scars left after phlyctenulæ, abscess, ulcer, wound, or inflammation of any kind. As already stated, a leucoma complicated with an entanglement of the iris (anterior synechia) is called 'leucoma adherens.' Slight nebulæ are often more embarrassing to sight than a dense but limited leucoma, inasmuch as the former are often widely diffused. If a leucoma have a well-defined margin, and if it do not cover the whole of the papillary area, there may be good vision past its edge. Old cicatrices are sometimes mistaken for actual keratitis. The polish on the surface of a leucoma, and the absence of circumcorneal injection and the other subjective and objective symptoms of keratitis, should ordinarily render diagnosis easy.

(*b*) *Glaucomatous opacity* appears as a diffused haziness of the whole cornea, with steaminess of the anterior surface, or, in later stages, as a transverse, semi-opaque stripe opposite the exposed part of the cornea. In cases of chronic glaucoma, minute vesicles or bullæ, with ulcerations, may be seen scattered over the surface of the cornea, or involving its depth. The cornea looks like ground glass, and its epithelium is rough.

(*c*) *Sclerosis* is usually the result of circumscribed interstitial keratitis. It occurs, therefore, at or near the corneal margin. *See* Cornea, Inflammation of the.

(*d*) *Calcareous Degeneration* of the corneal epithelium is a very rare condition. A case under the writer's care some years ago exhibited a lenticular-shaped streak crossing each cornea about the middle horizontal line, but inclining slightly obliquely down and out. Underneath the calcareous epithelium the cornea is generally clear.

(*e*) *Arcus Senilis* or *Gerontoxon* is said, on the authority of Canton, to be a degeneration of the periphery of the cornea. This opinion is probably erroneous. Many persons have arcus who show no other evidence of degenerative change; and besides there is no reason for believing that a cornea with arcus heals less readily after operation. The condition is probably rather sclerosis. It generally affects both eyes, and as its name indicates, is more frequent in elderly persons. It usually begins, as a whitish arc, just within the edge of the cornea at the upper and lower parts. A narrow band of transparent cornea is always left between the arc and the sclerotic. In course of time the ends of the upper and lower arcs join and form a white ring. It is always confined to the periphery of the cornea.

(*f*) *Metallic deposits* and *stains* are usually due to iron-rust or to lead deposit, and are removed by scraping and excision.

Treatment.—For cicatricial opacities, if repair be not complete, mild stimulating applications with frictions will often aid in the absorption of the inflammatory matters around and in the cicatrix, and thus help to thin them; but when repair is completed there can be little hope of removing the opacity. If practitioner and patient would recognise that the opacity is really a 'scar' a good deal of disappointment and misunderstanding might be avoided. If the opacity occupy the pupillary portion of the cornea, while the margin is clear, an artificial pupil opposite the clear portion may improve the sight. If, however, the sight be not impaired, or if there be no hope of improving it by operation, something may be done by tattooing the scar to render the blemish less conspicuous.

In glaucomatous opacities, as in ordinary cicatricial opacities, sclerotomy or iridectomy is often followed by considerable clearing of the cornea. In glaucoma, however, where the opacity is very pronounced, the disease is usually beyond any very effectual help from operation, inasmuch as degenerative changes have begun in the posterior segments of the eye, which contraindicate either iridectomy or sclerotomy. But even here eserine is often of service, both in relieving the pain and in removing the opacity. Calcareous epithelium may be scraped off, and so also may most of the metallic deposits and stains. In the case of lead deposit, however, the opacity implicates the stroma of the cornea, and must therefore be cut out with a fine knife. JOHN TWEEDY.

CORNEA, Variations of Curvature of the.—The cornea, as regards its curvature, is practically a section of a sphere. Any sensible deviation from this disposition gives rise to some impairment of vision. If the curvature alone be at fault, the result will be merely an error of refraction, with more or less astigmatism. *See* REFRACTION, Errors of. In many cases, however, both the curvature and the texture of the cornea are involved. In these cases alteration of texture has not only always preceded change of curvature, but is its predisposing cause. The textural defect may be due to want of development, or to intra-uterine disease, or to any subsequent morbid state of the cornea. From one or other of these causes, the resistance of the cornea is diminished, so that it cannot bear up against the intraocular pressure, and a bulging, or *ectasia*, results.

ECTASIA CORNEÆ may present itself in one of two forms, viz.:—

(1) Where the translucency is preserved, as in conical and globular cornea.

(2) Where there is more or less opacity—staphyloma.

(1) The TRANSLUCENT ECTASIÆ are (*a*) globular cornea, and (*b*) conical cornea.

(*a*) *Globular Cornea*, kerato-globus, buphthalmos, or hydrophthalmia, is usually congenital, and probably dependent upon corneo-iridian disease occurring during intra-uterine life. It may, however, occur from the same cause operating in early infancy. The cornea is expanded, and may be twice its natural size; the anterior chamber is deep, so that the iris, which is tremulous, seems to have receded; the pupil is distorted and probably adherent to the capsule of the lens; the sight is always impaired; the cornea itself may possess its normal translucency or be opaque in places. The disease usually affects both eyes, though one eye may be more affected than the other. In some cases the enlargement of the anterior segment of the eye may be so great that the lids do not cover it. Ulceration of the cornea is then apt to take place, which may ultimately demand excision of the globe. Otherwise there is little to be done in the way of treatment. Operations are hazardous in such eyes and rarely do good.

(*b*) *Conical Cornea*—Keratoconus.—As the term indicates, the curvature of the cornea in this affection is so changed that, instead of being spherical, it is conical. The conicity usually occurs about the centre of the cornea, and consequently its summit is opposite the pupil. In typical cases the appearance of the eye is characteristic. When looked at from the front, the cornea has a brilliant appearance, as if a drop of dew were lying on its surface; and when looked at in profile, the glistening apex of the cone becomes very conspicuous. The change of shape may often be easily demonstrated by placing the patient opposite a window and observing the alteration of form which the image of the window undergoes as the cornea moves from side to side or up and down. The surest way of discovering conical cornea is to throw light into the eye by means of a plane ophthalmoscopic mirror. A peculiar semi-rotatory dancing shadow is seen in the area of the red reflection as the mirror is rotated on its various axes. By this means, too, an apparent opacity is often observable, and when the optic papilla is examined by indirect ophthalmoscopy (*see* OPHTHALMOSCOPY), the image of the disc is easily distorted by slight changes in the position of the object lens. Both these phenomena are due to the irregular astigmatism produced by the alteration in the curvature of the cornea. In advanced cases there may be real opacity of the apex of the cone.

The chief subjective symptoms are weakness of the eyes and progressive impairment of sight. Distant objects are seen with increasing difficulty, reading becomes painful, and all near work has to be brought closer and closer to the eye. Hence the patient is thought to be growing short-sighted. These visual defects are but little, if at all, relieved by lenses. Indeed, it is often this circumstance that first suggests an examination of the cornea for conicity. When conical cornea has existed some time, more or less keratitis usually supervenes at the summit, followed by ulceration and cicatrisation. The progress may be slow or rapid. Though the apex of the cornea may be reduced to extreme tenuity, it rarely, if ever, gives way spontaneously.

Causes and Pathology.—The causes are not known. Most authorities believe the change to be of a glaucomatous nature. M. de Wecker has quite recently stated that it is unquestionably due to a glaucomatous state, though he admits the increase of intra-ocular pressure is never sufficiently pronounced to cause excavation of the optic papilla. (*Traité Complet d'Ophthalmologie:* Paris, 1883, t. ii. p. 193). Against this hypothesis must be put the fact that in most cases, and certainly in the worst cases, the eyeball is softer than natural. Indeed, in extreme cases, the apex of the cone actually leaks. Moreover, in conical cornea the anterior chamber is deep, and not shallow, as in glaucoma. Even if the bulging be indirectly dependent upon increased intra-ocular pressure, some other factor must be introduced to account for the *shape* of the bulging. Fluid pressure behind a spherical pressure does not produce a conical protrusion. The writer would suggest that the primary condition is a want of development of the centre of the cornea. In support of this hypothesis it may be mentioned that conical cornea is sometimes congenital, and often hereditary (the writer has known three sisters affected); it usually begins in childhood; it is often associated with a peculiar condition of the skin and teeth, due to ill-development. In typical cases the skin is pale, dry, harsh, and slightly sclerosed, either generally or in patches, with large sebaceous glands which are often blocked with blackened sebum; in some cases there is distinct though slight ichthyosis; the teeth are often honeycombed and deficient in enamel, resembling the teeth so frequently associated with zonular cataract. These facts all point to an embryological origin of conical cornea, and a reference to the mode of development of the cornea shows how a failure of the process of development may leave, in the centre of the cornea, a structural imperfection favourable to the formation of conical cornea.

Treatment may be palliative or curative. Palliative may, again, be local or general. Local: the lenses, spherical or cylindrical, combined, or not, with the stenopaic slit, which are found to give the best sight. Hyperbolic lenses have occasionally been found useful. Solutions of eserine are recommended, partly with a view to lessening the intraocular tension, and partly to diminish circles of diffusion by contracting the pupil. Formerly, the operation of iridodesis was practised, with a view of making the pupil stenopaic; but the operation has wisely been abandoned, on account of its liability to set up sympathetic ophthalmitis. In addition, avoidance of excessive near work is necessary. Small and long-continued doses of arsenic are worth trying, with the hope of favourably influencing the nutrition of the cornea.

The curative treatment varies with the theory of conical cornea. Those who regard keratoconus as glaucomatous adopt measures calculated to arrest the glaucoma, as iridectomy and sclerotomy, and the prolonged use of eserine. This is the line of treatment laid down by De Wecker. Graefe, on the other hand, attacked the apex of the cone, so as to induce cicatricial contraction. The theory propounded in this article indicates operative interference on the apex of the cone itself.

Von Graefe removed a thin layer from the apex without penetrating the anterior chamber. Two or three days later he touched the exposed surface with a stick of mitigated nitrate of silver, and repeated the application every three or four days, in order to set up ulceration. In the third week he punctured the anterior chamber through the base of the ulcer, and kept the opening free for from six to eight days, and then allowed it to heal by cicatrisation. The contraction of this cicatricial tissue led to the reduction of the conicity. This method has been variously modified by others. Bader, for instance, recommends the removal of a small and elliptical flap of the cornea, and bringing the lips of the wound together by means of one or two fine sutures. The practice which is now most commonly followed at Moorfields is that proposed by Sir William Bowman. With a suitable trephine a disc of cornea is cut, care being taken not to penetrate the anterior chamber. The disc is then seized with a fine forceps and severed by means of a cataract-knife. Atropine (or eserine) is then instilled, and the lids tied up with a moist or dry compress. In favourable cases, as cicatrisation of the corneal wound takes place, the conicity gradually disappears, a faint leucoma remaining. If necessary, the operation may be repeated, and eventually an artificial pupil may be made opposite a clean part of the cornea. In some cases the results of these three methods are really brilliant; but, unfortunately, they are all attended with considerable risk of suppuration of the cornea, and consequent destruction of sight. To lessen this risk, the writer has had recourse, in several instances, to multiple puncturings of the apex of the cone with a fine cataract-needle. The summit of the cone is transfixed from three to six times at each sitting, which may be repeated at intervals of two weeks or more. The first effect of the punctures is to allow some of the aqueous humour to escape, and then the eye is firmly but gently supported with a compress and bandage. The pupil is kept under the influence of eserine. Eventually a network of cicatricial tissue forms, which flattens the cone without giving rise to much corneal opacity.

(2) OPAQUE ECTASIA OR STAPHYLOMA.—This is bulging of a cicatrix involving any part or the whole of the cornea. It is, consequently, a result of inflammation or injury. In most cases, the inflammation or injury has been attended with perforation. It is especially common after purulent ophthalmia, and suppuration or ulceration of the cornea from any cause. In true staphyloma the iris is entangled in the projecting cicatricial tissue; hence the peculiar bluish appearance, from which the name staphyloma is derived (σταφυλή = a grape). The presence or absence of iris in the staphyloma determines, to a large extent, the gravity of the condition. When the iris is free, staphyloma rarely need give much anxiety; whereas if the iris be involved, there is always a possible danger of sympathetic inflammation of the opposite eye. The bulging may involve only a small portion of the cornea, or it may involve the whole extent. The prospect of recovering any useful degree of sight will depend largely upon the circumstance whether the staphyloma be partial or total.

Partial staphyloma is most frequently found in the lower part of the cornea, that is, the part corresponding with the palpebral aperture. Not only is this portion of the cornea more exposed to traumatic and septic agencies, but, being less supported by the lids, is more liable to give way when weakened by ulceration, or, later, by cicatrisation. On the other hand, staphyloma following purulent ophthalmia in adults is, perhaps, more common in the upper part of the cornea, the presence of the swollen upper lid favouring ulceration of this part.

In total staphyloma there is generally a large entanglement of the iris near the centre. The bulged portion may be so large that the lids cannot cover it. It has a bluish-white appearance, with several large conjunctival vessels running over it from the periphery towards the centre. There is generally a narrow zone of semi-transparent corneal tissue between the staphyloma and the sclerotic. In some cases, however, the sclerotic is also involved, or the staphyloma may be at the corneo-scleral junction—ciliary staphyloma. The amount of sight depends largely upon the extent of the staphyloma and the nature and amount of the implication of the iris. If the staphyloma be total, the sight will not be more than perception of light; but, if partial, there may be even good sight through the transparent portion of the cornea.

The chief complications of both partial and total staphyloma are glaucoma and sympathetic ophthalmitis. *See* GLAUCOMA; SYMPATHETIC OPHTHALMITIS.

Treatment.— The prophylactic treatment of staphyloma is identical with that of suppuration and ulceration of the cornea (q. v.). For small staphylomata, without enlargement of the iris, repeated punctures or incisions often suffice, but larger ones may need excision or abcision. When there is entanglement it should, if practicable, be liberated. This may be done either by iridectomy, or by excision of the portion of the cicatrix containing the iridian entanglement. A recent staphyloma is often greatly reduced by iridectomy, and useful sight may be secured. As a rule, however, staphylomatous eyes do not, under the most favourable circumstances, possess good vision, and are at best weak-sighted. If the bulging affect the whole of the cornea, and especially if it be increasing, so as to protrude between the lids and to prevent proper closure of the eye; and still more if there be ulceration with pain, then more radical procedures are called for, either removing the front of the eyeball—abcision—or excising the whole globe. It cannot be denied that ablation of the staphylomatous portion, inasmuch as it leaves a stump for an artificial eye, is a seductive procedure. But as after abcision the patient is still exposed to the risk of sympapathetic irritation and inflammation, it is not so much in favour as it formerly was. Of late, the practice of excising the eyeball altogether has steadily grown. By excision, the risks of sympathetic trouble may certainly be obviated, provided the operation be not delayed too long.

NEW-GROWTHS OF THE CORNEA.—Neoplasmata, beginning primarily in the cornea, are extremely rare. Tumours do, however, begin in the conjunctiva and invade the cornea, or the cornea may be invaded by tumours growing from within the eye. The new-growths which do occur in the cornea are epitheliomata and sarcomata. Pterygium is really an affection of the conjunctiva. *See* PTERYGIUM.

As soon as the nature of either is recognised, enucleation of the globe should be performed. JOHN TWEEDY.

CORNEA, Injuries of the.—The principal forms of injury of the cornea are abrasions, impaction of foreign bodies, wounds, and burns.

1. ABRASION of the corneal epithelium, though apparently a trifling accident, is always painful, and may be followed by suppuration and destruction of the cornea. The subjective symptoms are pain, photophobia, lacrymation, and a feeling as if grit were in the eye. Objectively, there is a disturbance of the polish of the corneal surface at the seat of the abrasion; though in the early stages the anterior elastic membrane continues to give a glistening appearance to the base. There is also more or less injection of the globe. The sequel depends upon the precise cause of the injury, the age, and health of the patient, and the kind of treatment adopted.

Treatment.—If the injury be inflicted with a clean instrument, and the patient be healthy, the instillation of a drop of castor oil, and tying up the eye with a soft compress for a few hours, may suffice.

But if the injury be inflicted with a foul instrument, as a dirty finger-nail, or if the patient be debilitated by want of proper food or by drains upon the strength, further precautions must be taken against suppuration. The eye should be tied up with a compress, which should only be removed to allow of the application of hot fomentations of water, poppies, or belladonna, and the instillation of atropine. An aperient should be given, if necessary, but care must be taken not to depress the nutritive activity. If the pain be very great, particularly over the eyebrow and at the root of the nose, one or two leeches should be applied to the inner or the outer angle of the orbit, followed by hot belladonna fomentations. If suppuration of the cornea and hypopyon occur, section of the cornea through the abscess should be made, with the double purposes of getting rid of the pus from the anterior chamber and of lessening the intra-ocular tension. As these untoward results rarely occur except in persons out of health, tonics and generous diet should be superadded to all local measures. Opium, croton-chloral, gelsemin, or conium may be necessary to give freedom from pain and to secure sleep.

2. FOREIGN BODIES of all kinds may be lodged in the surface of the cornea or become impacted in the deeper layers. In the latter case the track of the extraneous substance may be sagittal or oblique. The impaction of the foreign body may be further complicated by some peculiar quality of this substance; if it be a particle of hot metal there will also be some burning of the cornea; if it be septic, special reaction may follow.

In examining an eye with an alleged foreign body, it is necessary not only to look at the cornea in the manner directed above, but also to search the conjunctivæ of the upper and lower lids. Even though a foreign body be visible on the cornea, this precaution should not be neglected; otherwise extraneous matter may be left under the lids, to the annoyance of the patient and the discredit of the surgeon.

Treatment.—When the foreign body lies on the surface of the cornea its removal is easy. The application of a drop of a two per cent. solution of cocaine, five minutes before attempting the removal, will simplify matters by rendering the cornea and conjunctiva insensitive.

If the foreign body be deeply embedded there may be risk of pushing it through the posterior layers in the attempts to remove it. To obviate this a broad needle should be passed through the cornea behind the foreign body, but without penetrating the anterior chamber. The body may then be removed. But if the foreign body have penetrated the posterior layers and project into the anterior chamber, then the broad needle should be passed into the anterior chamber to support the inner end of the particle, while attempts are made to remove it from the front. Lastly, if the foreign body be forced through the cornea into the anterior chamber, the cornea should be incised, as for iridectomy, and the foreign body removed by forceps, with or without excision of the iris. If the foreign substance be iron or steel it may conveniently be withdrawn from the chamber by means of the electro-magnet. Before attempting to remove fragments that are deeply embedded in the cornea, or which have penetrated the cornea, it is well to apply eserine, in order to contract the pupil and thereby lessen the risk of wounding the lens.

After the body has been removed, a drop of castor oil should be applied and the eye tied up a few hours or two or three days, according to the severity of the injury. Should keratitis supervene it must be treated on the principles laid down above.

3. Wounds of the Cornea may be classified as incised, contused, lacerated, punctured, poisoned, and complicated.

Incised wounds are usually simple in character, and seldom need give anxiety. Contused, lacerated, punctured, and poisoned wounds, on the other hand, are apt to be followed by suppuration. The most serious wounds, however, are those which are complicated by prolapse and entanglement of the iris, by wound of the capsule of the lens, by dislocation of the lens, or by involving the corneo-scleral region, and implicating the ciliary body.

Treatment.—In simple wounds atropine should be applied, and the eye tied up with a light compress. In wounds of a severer kind belladonna compresses, and every other means of preventing or allaying inflammation, should be used. The sound eye should also be protected by means of a shade or tinted spectacles.

Complicated wounds must be treated according to the nature of the complication. If there be a simple entanglement of the iris, an attempt may be made to return the iris; but this failing, the prolapsed portion should be firmly grasped with iris-forceps, and gently pulled forwards so as to detach it from the margin of the wound; and then, while thus over-stretched, it should be excised close to the cornea. The resiliency of the iris will draw the stump of the iris into the anterior chamber, and thus prevent further entanglement. Avoidance of entanglement is one of the surest precautions against sympathetic ophthalmitis. If there be a large perforating wound of the cornea with a hernia of the lens, iridectomy should be performed and the lens removed. *See* Cataract. In all cases of wound the local treatment must be soothing and mildly antiphlogistic, and inflammatory reaction should be combated in the manner indicated under *Keratitis*: see Cornea, Inflammation of the.

4. Burns of the Cornea may be caused by hot metals, sparks, lime, ammonia, mineral acids, &c. Burns with lime and strong ammonia are the most destructive, and are apt to cause suppuration or necrosis, and are, under the most favourable circumstances, followed by leucomata. Such burns generally involve the conjunctiva and lids also, and may give rise to adhesions of these parts to the cornea. *See* Conjunctiva, Injuries of the; Eyelids, Injuries of the.

Treatment consists of the removal of all foreign particles, and, if the case be seen early enough, by the neutralisation of the chemical substances—of alkalies by weak acids, of acids by weak alkalies. Later the treatment should be directed against inflammatory reaction, and to putting the cornea in the most favourable state for recovery with the least amount of damage. *See* also Conjunctiva, Injuries of the; Crystalline Lens; Eyelids, Diseases of the; Iris, Injuries of the.

J. Tweedy.

CORNS.—*Definition.*—Local hypertrophies of epidermis, due, for the most part, to the intermittent friction of ill-fitting boots.

Boots, especially of women from their absurdly small size and high heels, throw abnormal pressure on certain spots: but misshapen, loose, ready-made boots may also produce corns by friction. Corns are especially met with on the dorsal surface of the phalanges doubled down and driven under one another, on the outer surface of the little toe, and over the heads of the first and fifth metatarsal bones.

Structure.—This varies somewhat according as corns are hard or soft. (*a*) The structure of *hard corns* is that of a wedge or column-like mass of epithelium, which is driven down on the subjacent papillæ; these soon become depressed and atrophied, the subcutaneous fat disappears and a small bursa often forms, to keep off the pressure on the parts below. (*β*). *Soft corns.*—The chief difference between these and hard corns is that, occurring as they do between the toes, they are spongy, vascular, and covered with soft macerated epithelium. The writer has met with them especially in summer, and in the wearers of patent-leather boots.

The importance of corns depends on the trouble which they occasion, and their *complications*. In early life lateral curvature may take its starting-point in a painful corn, the girl throwing her flexile spine over on to the opposite foot. Abscess under a corn, due to suppuration in the little subjacent bursa; partial dislocation of one or more toes at the metatarso-phalangeal joints due in part to reflex contraction set up by the corns, and in part to the same pressure which has caused the corns, are not unfrequently met with in patients who are well-to-do. Amongst the poorer classes neglected corns have been complicated with cellulitis and erysipelas, or have even, in elderly people, become the starting-point of a fatal gangrene.

Treatment.—The cure of corns would be easy by removing their cause; but few patients obtain a radical cure, as their perseverance ceases as soon as they obtain a sufficient but temporary relief. As a rule patients act upon a too widely spread opinion, viz., that medical men do not know how to treat corns, or, if they do, think them beneath their dignity, and go to some self-dubbed 'chiropodist,' or only present themselves for the treatment of inflammation or some other complication of corns. A medical man should always insist on his patient wearing properly made and well-fitting boots or shoes: these should be neither too large nor too small, with a straight inner border, rounded, not pointed, toes, and low heels; the boots, moreover, should allow of sufficient spring and expansion of the foot in every direction at every step. Patent leather should be forbidden, and the material used be as soft and supple as possible.

In the removal of corns the surgeon should pare a little of the top off carefully, without any attempt to 'cut out' the corn, and then apply, on one or two occasions, a little nitric or glacial acetic acid. A few days after each application the thickened cuticle can be peeled off and a fresh application made, two or three of which are usually sufficient. Of course neither these remedies nor the silver-nitrate in stick (to which the writer considers the former superior), are to be used when the corn is at all inflamed, and in elderly people with feeble circulation, any interference with corns must be undertaken with caution, for fear of causing inflammation which may pass into gangrene. If the patient object to caustics he may apply at night water dressing or a solution of sodæ bicarb., or one of caustic potash well diluted, on lint or cotton wool. A few applications of this will macerate away the chief part of the corn, and the rest will shrivel away, if the patient, having dried the corn well, paint on a solution of silver nitrate, gr. x.–f℥j.

Relief may be given, when any further treatment is declined, by the use of circular perforated plasters of amadou, 'elephant' plaster, or buckskin; but it is always to be remembered that these remedies, while pleasing to the patient, do not cure the corn.

Suppuration under a corn may be known by the presence of a yellow speck at the base of the corn, ushered in by intense throbbing pain. A puncture should be made with a tenotomy knife, and the parts relaxed by the constant application of warm water dressing. Where a row of corns occurs on the phalanges of the toes, crooked and crumpled by the pressure of ill-fitting boots, the toes must first be straightened by splints, aided, if needful, by tenotomy. *See* HAMMER-TOES.

Obstinate ulceration occasionally follows on suppuration and inflammation of corns. *See* PERFORATING ULCER.

Moist corns, between the toes, may easily be cured by keeping the parts very dry, dusting with zinc oxide and starch, or pulv. æruginis, and painting occasionally, if need be, with solution of silver nitrate, gr. x.–f℥j. If moist corns are accompanied by 'sweating feet,' the patient should bathe his feet frequently, and after thorough rubbing and drying, apply lin. belladonnæ, or equal parts of this and eau de Cologne. Socks or stockings, shoes or boots, should be frequently changed. *See* Bromidrosis.

W. H. A. Jacobson.

CORNUA CUTANEA. *See* Horns.

COSTAL CARTILAGES, Fractures of the.—These are very rare, and generally due to the same causes as those giving rise to fractured ribs. The cartilages from the fifth to the ninth are those most likely to be injured. They are frequently complicated by fracture of the sternum, and it is said that injury to the eighth cartilage occasionally may rupture the transverse colon. The pericardium and heart are, however, the thoracic viscera most likely to suffer. The treatment should be the same as for fractured ribs; but if there be deformity a pad and spring pressure may be used to correct this, the elastic structure of the cartilage yielding under the constant pressure. The cartilages generally unite by bone-callus, formed around the broken ends which remain passive in the sheath; but occasionally they unite by new cartilaginous material.

H. G. Howse.

COUNTER-OPENING.—If, after incision of a suppurating cavity, the opening fails to afford free exit to its contents, and the pus either collects at a lower level or has a tendency to burrow along the adjacent soft parts, it will be found necessary to make another incision—the so-called *counter-opening*—in a more dependent or suitable situation, in order to remove this accumulated and probably decomposed purulent discharge. *See* Abscess.

COXALGIA. *See* Hip-Disease.

CRADLES are light arched frames made of wire or cane, which are used to protect injured or inflamed parts from the pressure of the bedclothes. They are made of various sizes, some of sufficient span to bridge across the body, and others merely across a limb. Some cradles, such as Salter's or Arnold's, are of a stronger build, and adapted to suspend a broken limb or diseased joint in a swinging position. In the former the swinging apparatus is suspended from a pulley running on a longitudinal bar; this contrivance prevents the limb being disturbed if the patient slip lower down in the bed. Bilton Pollard.

CRANIAL NERVES, Injuries of the.—I. The Olfactory Nerve.—Blows or falls on the head not infrequently cause separation of the nerves from the lobes, when olfactory anæsthesia—i.e. anosmia—ensues. Loss of the sense of flavour is first noticed, but afterwards that of smell is appreciably lost, as made out by presenting an aromatic oil, such as that of cinnamon or clove, to the nostril. Acetic acid or ammonia irritate the fifth nerve, not the olfactory, and are therefore apt to mislead.

II. The Optic Nerve.—Injuries to the optic nerve, chiasma, and tract exhibit symptoms which depend on the part injured.

Injury to one optic tract causes loss of sight in the corresponding half of the field of vision of either eye—*lateral hemiopia.* This is accounted for by the crossing of the inner set of fibres at the chiasma, so that each tract supplies the same side of both eyes. Injury of the optic chiasma at its margins causes loss of the power of vision on the outer side of both retinæ, appearing in projection as loss of vision in the inner part of each field, i.e. *nasal hemiopia.* Injury to the centre of the chiasma causes loss of function in the inner part of the retinæ, appearing in projection as loss of the outer half of each field of vision, i.e. *temporal hemiopia.*

Destruction of the nerve between the chiasma and the optic foramen causes simply blindness. Injury to the nerve at the optic foramen or within the orbit usually involves other orbital nerves.

III. The Third Nerve is distributed to all the muscles of the eyeball, except the superior oblique and external rectus; to the levator palpebræ; to the sphincter pupillæ, and to the ciliary muscle. *Irritation* of the nerve causes spasm of some one or all of the muscles supplied, but most frequently it is the lateral rectus which is affected, causing internal strabismus; the sphincter pupillæ, causing myosis; and the ciliary muscle, causing the eye to be accommodated for near objects only.

Complete paralysis causes :—

1. Ptosis.
2. Immobility of the eyeball in the position of external strabismus.
3. Dilatation of the pupil.
4. Loss of the power of accommodation.
5. Slight prominence of the eyeball from the compressing action of the superior oblique.

Diagnosis of the seat of lesion :—

1. Injury to the nerve in the crus causes coincident hemiplegia of the opposite side.
2. Both nerves are affected when the interpeduncular space is the seat of lesion.
3. Paralysis of the internal rectus alone causes divergent strabismus and crossed diplopia.
4. When the superior rectus is paralysed, there is crossed diplopia in looking upwards.

5. Exactly the reverse obtains when the inferior rectus is paralysed.

IV. The Fourth Nerve when paralysed causes loss of function in the superior oblique muscle. Owing to the consequent loss of power of rotating the eyeball downwards and outwards there is diplopia, when the patient attempts to look obliquely downwards, from the healthy towards the paralysed side. Giddiness when descending a stair is usually the first symptom, owing to the diplopia induced by looking at the steps whilst descending.

V. The Fifth, Trigeminal, or Trifacial Nerve may be affected in its entirety, in its motor root alone, or in one or more of its primary divisions.

Of the three primary branches the first, wholly sensory, supplies the forehead, upper eyelid, the conjunctiva, the inside of the inlet to the nose and the lacrymal gland. The second, wholly sensory, supplies the cheek from the lower eyelid to the upper lip, including both; the side of the nose, and the upper gums and teeth. The third, partly motor, partly sensory, supplies with motor power the muscles of mastication; and by its sensory branches the lower lip and cheek, the gums and teeth of the lower jaw, the anterior two-thirds of the tongue, the front of the ear, and the parotid gland.

Paralysis from an injury dividing the *sensory* root causes anæsthesia of the regions between the frontal suture and the lower jaw, and between the middle line of the face and the ear. The skin of the face is cold to the touch and exhibits a purplish tint. The conjunctiva may be touched without causing winking, the eyeball looks glazed, and in the course of eight days, if unprotected, the cornea may slough, allowing the escape of the contents. The nostril is dry, and irritation produces neither watering at the eye nor sneezing. The effect of unilateral paralysis causes the patient to think the glass from which he drinks is broken. The tongue on the affected side loses the power of appreciating the presence of sweet, sour, bitter, or saline substances. The gums become spongy and ulcerative. There is diminished secretion in the lacrymal and the salivary glands. Paralysis from severance of the *motor* root is evident by the impaired action of the lower jaw, and by the loss of strength in the masticatory muscles. Irregularity of movement becomes evident, and by placing the hand on the cheek of the affected side, the defective power of the muscles becomes apparent. The impairment in lateral movements is more diagnostic than the simple up and down movement. The diagnosis between central and peripheral affections is made out by observing the following points.

1. When central, the lesion of the fifth is associated usually with hemiplegia of the same side, i.e. the side opposite to the injury.

2. In peripheral affections the anæsthesia is more complete, and in it the trophic and vaso-motor changes are pronounced.

VI. The Sixth Nerve—the abducens—supplies the external rectus of the eyeball. This nerve, on account of its connection with the basal cranial bones, is more frequently involved in fractures of the anterior part of the skull than is any other of the orbital nerves. Its division causes internal strabismus. There is a default in the projection of the field of vision, diplopia of the homonymous type, the images appearing more distant as the object is moved across the field of vision towards the affected side.

VII. The Facial Nerve, or portio dura of the seventh, when torn through, causes paralysis of the muscles of expression—Bell's paralysis. The nerve may be injured after, during, or before its passage through its canal in the petrous portion of the temporal bone—the aqueductus Fallopii.

Injury after its exit from the bony canal causes paralysis of all the muscles of expression—i.e. all the facial muscles, with the exception of the levator palpebræ—of the posterior belly of the digastric, and the stylo-hyoid muscles. The symptoms are:—1, smoothness of the forehead; 2, inability to close the upper eyelid; 3, smoothness of the cheek; 4, loss of the naso-labial furrow; 5, inability to expand the nostril; 6, on laughing the mouth is pulled towards the sound side; 7, whistling, or blowing a candle out, is impossible; 8, food collects between the cheek and the gum. When the injury is three lines *above the exit* of the nerve from the canal, the chorda tympani is paralysed. The patient then experiences a pasty taste in the mouth, and is unable to recognise the difference between bitters and sweets, acids and salines.

When the injury is near the entrance of the nerve into the canal, then the petrosal nerves are involved. See *Spinal Accessory.* When the nerve is injured before its entrance into the canal, the auditory is usually involved. When the cause is central, the sixth is usually paralysed, and there is hemiplegia of the opposite side. When central, the electric response of the muscles and nerves remains active, but when peripheral it is usually lost.

VIII. The AUDITORY NERVE is frequently destroyed by fractures of the base of the skull, by blows, by loud, sudden noises or explosions, as of dynamite. The inability to hear a vibrating tuning-fork placed on the cranium or between the teeth, is diagnostic of complete destruction. Irritation of the part of the nerve supplying the semicircular canals is supposed to produce the giddiness, vertigo, and vomiting characteristic of Menière's disease. *See* EAR, INTERNAL, Diseases of the.

IX. The GLOSSO-PHARYNGEAL NERVE.—Injury to this nerve is unknown apart from its neighbours. When it is destroyed taste proper is lost, and various muscles of the palate are affected. See *Spinal Accessory.*

X. The PNEUMOGASTRIC NERVE, and the part of the spinal accessory applied to it, must be considered together. These endow the circulatory, respiratory, alimentary, and urinary tracts with motor, sensory, trophic, vaso-motor, vaso-inhibitory, secreto-motor, inhibitory, and accelerating fibres.

If the *trunk* of one vagus is destroyed near its root, respiration becomes slower, and, if both be divided, the pauses between inspiration and expiration become more marked, the patient dying of pneumonic congestion. When the pharyngeal branch is destroyed deglutition is impaired, food collects in the pharynx, and fluids taken are ejected through the nose. This probably indicates paralysis of the palatal, as well as of the upper constrictor muscles.

Division of the superior laryngeal nerve allows food to enter the senseless larynx, causing thereby asphyxia. Division of the inferior laryngeal causes paralysis of all the muscles of the larynx, except the crico-thyroid supplied by the superior laryngeal. When this is unilateral, one vocal cord is useless, and being at first semi-abducted and then adducted, causes the voice to be at first hoarse and finally high-pitched. The change is, in all probability, brought about by the increasing tension of the crico-thyroid. Dyspnœa supervenes only during exertion, owing to the inaction of one vocal cord.

When the trunk of the pneumogastric in the neck is paralysed, the recurrent laryngeal suffers; the respirations become slower, the cardiac beat is quickened, and death ensues, usually within half an hour. If, in an operation, the pneumogastric is pulled upon, the heart's action is slowed.

XI. The SPINAL ACCESSORY NERVE.—The accessory filaments to the vagus and its branches supply motion to its pharyngeal, laryngeal, and, probably, its respiratory and cardiac, branches. The portion which takes a separate course supplies the sterno-mastoid and upper part of the trapezius muscles. Irritation of the nerve-trunk causes spasm of these muscles; complete division paralyses them. The head can be maintained in the erect normal position; but shrugging the shoulder, or turning the head so as to hear better, are impossible movements on the paralysed side.

The muscles of the soft palate are affected in paralysis of the fifth, facial, glosso-pharyngeal, pneumogastric, spinal accessory, and hypoglossal nerves. Anatomical teaching ascribes the nervous supply of these muscles to the facial through the fifth for the most part; but clinical observations do not bear out this teaching, as deviation of the uvula—a doubtful symptom at any time—is found when other than these nerves are injured. At present, it is safest to make no definite statements until anatomical and clinical observations are more in accord.

XII. The HYPOGLOSSAL NERVE is chiefly devoted to supplying the muscles of the tongue.

In bilateral paralysis deglutition, mastication, and articulation are hindered or impossible. In unilateral affections these are but little affected, but on protrusion of the tongue it is easy to be seen that it is pushed to the affected side, and *vice versâ* when withdrawn. Paralysis of the palate and one vocal cord has been observed in a case of unilateral paralysis.

JAMES CANTLIE.

CRANIOTABES — CRANIAL BOSSES.—By craniotabes is meant a special form of atrophy, or thinning, of the cranial bones in infancy. The parts affected become flexible like parchment, and small conical pits are formed which commence on the inner table and extend outwards, leaving in well-marked cases only a lamina of the external periosteum. The parchment-like flexibility is easily appreciated when gentle pressure is applied; but the pits are difficult to demonstrate during life, because, except in extreme cases, the outer table retains its continuity of surface. The part of the cranium commonly affected is the posterior inferior angle of the parietal (on one or both sides), and in this position the bone is more easily bent by the finger than in any other, and such bending as can be obtained with moderate pressure is not attended with either risk or pain to the child. There are no symptoms specially suggestive of craniotabes. Infants who have the lesion highly marked, are sometimes very tender about the head, and cry when raised from the horizontal position; but this is by no means constant. The back of the head is often bald. Elsässer, who gave the first description of the lesion, and whose monograph (1842) is admirable, was inclined to look upon craniotabes as the cause of laryngismus stridulus; but there seems no sufficient reason to suppose that the two things, when they coexist, are more than coincidences. It is certain that many cases of craniotabes exist without laryngismus, and many cases of laryngismus occur in children who are not craniotabetic.

The age at which craniotabes is first found is of some importance. There are some exceptional cases in which it appears to be a fœtal condition, and these have special features to be subsequently mentioned; but there is no doubt that craniotabes, as commonly met with, is an infantile and not a congenital lesion. The bones of the vault of the cranium of a full-term fœtus will be found, on examination, tough, firm, and unyielding. Change in shape of the skull of a new-born infant under pressure, is brought about in great part by the overlapping at the sutures, not by the bending of bones. There may be a little yielding along the margin of the sutures; but flexibility of the bone beyond, and actual pits, rarely occur before three months, although they have been detected as early as six weeks. The onset of craniotabes has been repeatedly recognised in infants who were under frequent observation early in life, and who when first examined showed no sign of it. With respect to duration, this lesion may be only capable of detection for a few weeks; in the majority of cases it ceases to be recognisable within the first ten or twelve months of life, but it may continue, in rare cases, up to eighteen months.

The post-mortem appearances present the shallow conical pits already mentioned. These pits are excavations primarily of the inner plate, whilst the apex of the cone is hollowed out of the outer plate, which, in extreme cases, is reduced to a mere membranous lamina of periosteum. The walls of the pit present a markedly granular surface. The size is rarely greater than enough to hold the end of a cedar pencil; the number varies from two or three to a dozen. The pits are generally symmetrical, but deeper and more numerous on one side than the other. The 'place of election' is the posterior inferior part of the parietal. With less frequency the thin upper portion of the occiput, the temporals, the upper surface of the orbital plates of the frontal, and very rarely the upper parts of the frontals and parietals are affected.

Three associated cranial conditions deserve special notice:—(1) The excessive, or rather the premature, formation of convolution-impressions in the hinder parts of the skull. The craniotabes pits are, without exception, situated in these early-formed convolution-impressions. (2) Where the craniotabes is considerable, there is generally also some asymmetry of the skull, and it will be found that, on the side on which the pits are deepest and most numerous, the posterior parietal region is flattened, as a whole, compared with the other side. (3) Cranial bosses. Spots of craniotabes will be found *post mortem* in most of the cases of the so-called natiform skull of M. Parrot, in its vascular and active stage. In this form of cranium, massive bosses occur around the anterior fontanelle, and more or less broad sinuous areas of osteophytic deposit surround, but rarely invade the centres of ossification of the frontals and parietals, and sometimes the occiput and temporals. The association of massive hyperostoses in definite parts of the skull with atrophic areas in other definite parts, is a very remarkable one. Now although a multitude of cases of craniotabes may be found in which at no period are definite bosses to be made out during life, yet a minute examination, *post mortem*, of the outer surface of the cranium in the neighbourhood of the tabetic spots, will, the writer believes, almost invariably reveal a deposit of fine, granular, osseous material. This is sometimes only comparable with what would be obtained by sprinkling over the bone the finest sand. In other cases it is more marked, and can be identified as a 'splash,' so to speak, of the same kind of granular osteophytic deposit which, by insensible gradations, is traceable into the massive bossy growth before mentioned.

Etiology.—No entirely satisfactory explanation of the causation of craniotabes has been offered. The view that the pits represent islands of incomplete ossification in the membranous bones of the cranium is certainly untenable, at least so far as the ordinary cases are concerned. Delayed ossification is by no means a rare condition along the posterior border of the parietal, and along its upper margin, especially near the position normally occupied by the parietal foramina, and such delay may explain some of the flexible parietals which are felt during life; but the actual pits which are seen *post mortem* are well within the sutures, and cannot be so explained. It is true that in skulls of infants who are the subjects of meningocele, small gaps of incomplete ossification may be found in various parts of the cranial bones; but the inner surface of these gaps is quite smooth, instead of presenting the rough granular condition of craniotabes pits, whether the latter have progressed to actual perforation or stopped short of it.

There seems every reason to regard the true craniotabes pits as being due to an actual removal of osseous material from the inner surface by a process of absorption. The doctrine which finds most favour is that the weight of the brain is the efficient cause of this absorption, by pressing against the thinner portions of the hinder part of the cranium, which hinder part also is subjected to counter-pressure from the frequent horizontal posture of the infant lying against the pillow, or on the arm of the nurse. However brought about, it seems probable that in the formation of the convolution-impressions, which are not present at birth, a certain amount of absorption of osseous material takes place. It is possible that an amount of absorption, enough to allow of a slight degree of flexibility of the posterior parietal regions, may be physiological. The writer has, in more than one instance, observed the occurrence of a slight degree of flexibility lasting for a few weeks in a perfectly healthy infant of between three and four months old. But Friedleben's view that actual craniotabes, with the formation of pits, is physiological, appears to the writer quite untenable.

To the two factors of weight and resistance before mentioned, it would appear essential that a third should be added, viz., a special morbid condition of bone by which it becomes more readily acted upon, from within and without, than in the normal state. The writer has already stated his belief that, in however attenuated a lamina, some evidence of fine granular deposit of osteophytic material can generally be found on the outer surface in the neighbourhood of the pits. In the active vascular stage, even the osteophytes which form the massive bosses are so soft that they can readily be cut with a knife. These portions, it is to be remembered, are not subjected to pressure and resistance like the posterior parietal regions. The premature formation of convolution-impressions on the inner surface, and the very marked general flattening of the whole of one posterior parietal region, so often found with craniotabes, form together a strong presumption in favour of the plasticity of this part of the skull. It is true that such asymmetry may be congenital, but its onset may be actually observed in some of the above cases, along with evidences in other parts of the skeleton of yielding to pressure.

It must be admitted that the above view does not explain the rare cases of craniotabes of the upper parts of the frontals, and of the parietals. The full history of these cases is much to be desired, especially with regard to the date of onset. Is it possible that some of them may be truly congenital, and so comparable with a remarkable group described by M. Parrot? This group consisted of premature still-born fœtuses, and the pits were found distributed with remarkable constancy around the neighbourhood of the anterior fontanelle. M. Parrot's ingenious contention was that in intra-uterine life, the head being generally dependent, this region of the inner surface of the skull would be very liable to pressure, and that if any localised morbid condition of bone occurred rendering it soft in this region, intracranial pressure might be expected to come into play.

The question now arises, with what general morbid condition is infantile craniotabes related?

1st. It is not necessarily associated with simple general atrophy or marasmus. Dr. David Lees examined a number of marasmic infants in whom no craniotabes could be found; and, on the other hand, the lesion has been found repeatedly in many stout, apparently well-nourished, children.

2nd. It is certainly found in a high degree in many syphilitic children, and is regarded by M. Parrot as always syphilitic; but it is equally certain that in many cases no evidence of congenital syphilis is forthcoming.

3rd. The prevalent view, first propounded by Elsässer, supported by Virchow, and accepted by most German writers, is that craniotabes is the earliest manifestation of rickets. With respect to this view, it is undoubted that craniotabes may be found in breastfed infants, who at the time present no other sign of rickets, so far as can be detected during the life of the infant, although it may be urged that at a subsequent period, beading of ribs, &c., may become manifest. The writer has, however, recorded one case of craniotabes in a probably syphilitic breastfed child in whom post-mortem examination revealed no proliferation of cartilage at the sternal ends of the ribs, although the child was seven months old, a sufficient age for beading to have become manifest.

The question, however, ultimately turns upon the interpretation which is to be given to the nature of the cranial osteophytes which, in larger or smaller amount, the writer believes always accompany definite spots of craniotabes. If these osteophytes are, as M. Parrot taught, to be regarded as syphilitic, then the craniotabes spots ought to be regarded as a sort of syphilitic epiphenomenon. If, however, the osteophytes are rickety, then the craniotabes spots ought to be considered as a sort of rickety epiphenomenon.

The writer has observed some notable examples of cranial bosses in syphilitic infants in whom other signs of rickets were either *nil* or extremely slight, and, for this and other reasons, was at one time led to believe that M. Parrot's view was correct, viz. that the cranial bosses were in themselves syphilitic. Subsequent investigation has convinced him, however, that, although such bosses occur in a large number of syphilitic children, they may unquestionably arise in non-syphilitic children, and that the older view, according to which they were held to be rickets of the skull, was the correct one.

The difficulty that occasionally other signs of rickets are slight, or even absent, is a real one; but it may be partly met by the parallel observation of the occasional excessive incidence of this disease on particular bones or portions of the skeleton, and by the wonderful variety of clinical forms which occur in consequence of the commencement or arrest of the disease at varying stages of bone-development. The readiness with which the osseous system of a child responds to the slightest perversion of general nutrition is one of the most striking facts of pathology. It seems possible that, even in a breastfed infant, some temporary impoverishment of the mother's milk, some slight chronic catarrh in the infant, or some fault in its surroundings, may start a change in the growing cranial bones, and lead to the deposition of morbid osseous material, in consequence of which craniotabes may follow, and, the cause having come to an end, no further affection of the skeleton supervene.

Thus, as rickets, in its well-marked indubitable forms, may become arrested at various stages, and healthy development occur, so the view may be held that the craniotabetic phase of rickets may remain the only manifestation of the disease, and thus the difficulty of the frequent non-appearance of other classical signs would be met.

Treatment.—Craniotabes, so far as the writer knows, is attended with no special risks *per se*, and needs no special treatment; but its detection ought to set the doctor on the *qui vive* for faults of diet and hygiene, even if no other evidence of rickets be present at the time; and if evidence of congenital syphilis be forthcoming, the child should be promptly treated with mercury. Thomas Barlow.

CREPITUS. *See* Fractures.

CRIPPS' LONG SPLINT, for fractures of the thigh, differs from all others in that the extending and counter-extending forces are both obtained by the elasticity of a rubber accumulator. The splint is provided with a sliding footpiece, from which a cord passes round a pulley, and then upwards along the outer side of the splint to a double pulley, around the lower wheel of which it is reflected, and then fixed to the upper end of the accumulator, which is itself attached at the other end to one of a series of hooks on the outer side of the splint. The perineal band terminates in a cord at each end; both cords pass over a pulley let in to the upper end of the splint, and join on the outer side of the splint to form a loop, which is placed on the upper wheel of the double pulley above mentioned. It will be seen that when the accumulator is put on the stretch traction is thus made on the perineal band at the same time as on the footpiece. Bilton Pollard.

CROFT'S PLASTER OF PARIS SPLINTS. *See* Immovable Bandages.

CRYPTORCHISM. *See* Testis, Malpositions of the.

CRYSTALLINE LENS. — The crystalline lens presents abnormal and morbid conditions of several kinds. Its *transparency* may be impaired or lost through faults of development or growth, through injury, through senile degeneration, or through malnutrition due to disease of the structures which surround it. Its *elasticity* may be destroyed by the usual senile sclerosis of the fibres, or by morbid changes of structure at any time of life. Its *form* and *size* may be abnormal, by reason of errors of development and growth, or of the mechanical pressure of surrounding structures. Its *position* and *relations* may be at fault through malformation or rupture of its suspensory ligament, through defect of the aqueous or vitreous humour, through adhesion to the iris or other adjacent parts, or through the presence of foreign bodies or new-formations in its neighbourhood. Having no nerves, no blood-vessels, and no connective tissue in its substance, the lens is not subject to those morbid processes which depend on the presence of these structures. Its most frequent and most important disorder is the condition known as cataract. *See* CATARACT.

MISPLACEMENT AND DISLOCATION OF THE LENS.—Instead of hanging evenly suspended behind the pupil and concentric with the axis of the eye, the lens may assume various abnormal positions. It may be displaced laterally with or without tilting of the one edge in advance of the other; it may pass through the pupil into the anterior chamber; it may fall back into the vitreous humour; it may even, in case of forcible rupture of the sclera, be driven out of the eye and remain lying beneath the conjunctiva.

Causes and Pathology.—The causes of these displacements are of three kinds—errors in development; injuries; and degenerative processes affecting the integrity of the suspensory ligament.

Congenital misplacement is sometimes associated with coloboma of the choroid or optic disc, sometimes with persistent hyaloid artery; more frequently it is met with in eyes which appear otherwise healthy. A partial lateral displacement indicates a faulty development of the suspensory ligament, by reason of which the traction upon the lens is unequal at different parts of its circumference. The displacement is usually upwards, or upwards and outwards, indicating a defect in the lower part of the ligament analogous to an imperfect closure of the fœtal slit. It is usually present in both eyes, and is symmetrical, or nearly so, in the two. It has been frequently met with in several members of one family, and in successive generations.

Traumatic dislocation may be produced by perforating or by non-perforating injuries, more frequently, perhaps, by the latter; the suspensory ligament ruptures under violent distortion of the globe, and the lens is displaced in the direction of least resistance. The attachments of the lens to its ligament and to the hyaloid membrane are less strong in senile than in youthful eyes, and they are weakened by conditions which damage the nutrition of the vitreous humour; in such cases, therefore, less force suffices to dislocate the lens than in a sound and youthful eye.

Spontaneous dislocation occurs only in presence of morbid changes in the lens itself, or in the vitreous. These structures depend for their nutrition upon the uveal tract, and when this latter passes into an atrophic state—e.g. in retinitis pigmentosa, choroiditis disseminata, extreme myopia, &c.—they are apt to degenerate, the one liquefying, the other developing the posterior-polar form of cataract. It is in these same conditions of uveal atrophy that spontaneous dislocation of the lens is chiefly met with. It is promoted also by those pathological changes which overstretch the suspensory ligament, namely, by the shrivelling of the lens which usually occurs in the hypermature stage of cataract, and by the distension of the ciliary region which results from the long continuance of glaucomatous tension. A lens misplaced at birth may, and not unfrequently does, in course of time break loose still further from its suspensory ligament, and undergo a spontaneous dislocation into the vitreous or the anterior chamber; the deep-seated changes just referred to are, of course, not to be looked for in such a case.

Symptoms and Diagnosis.—*Lateral displacement*, such as occurs congenitally, involves more or less defect of vision; usually there is myopia, and sometimes astigmatism also. If the displacement be so great as to bring the one edge of the lens well within the area of the pupil, the eye has, as it were, a double refraction, being, as regards the free part of the pupil, hypermetropic, as in aphakia (absence of lens); while, as regards the part occupied by the lens, it is myopic, or, at any rate, very much less hypermetropic. Moreover, the retinal image is doubled, for the eccentric lens acts as a prism, and deflects to one side the rays which traverse it, while those which pass by it are not so deflected. Hence the patient has a peculiar confusion of vision, and may see double with a single eye. A concave lens, combined, if necessary, with a cylinder, may give good vision through the displaced crystalline, while a cataract-glass may do the same for the free area of the pupil. In either case, the patient may succeed in disregarding the second image, especially as by the action of the glass it is rendered all the more diffuse. Objectively, the displacement reveals itself by tremulous movements of the iris when the eye is quickly moved in different directions.

These indicate a loss of the fixed support which the iris normally receives from the lens, and correspond with similar tremulous movements of the lens itself. The anterior chamber is seen on careful inspection to be unequally deep at different parts, being too shallow at the side towards which the lens is displaced, too deep at the opposite side. With the ophthalmoscope the edge of the lens presents the striking appearance of a dark line, well-defined on its convex side, shading off more gradually on its concave side, crossing the pupil near to its margin. If the displacement be slight, the dark line will be visible only on looking obliquely behind the margin of the pupil. It is due to the fact that rays of light falling on the extreme edge of the lens strike it at such an angle as to be totally reflected from its surface, instead of passing through it. The free area of the pupil gives a brighter reflex from the fundus than the part occupied by the lens, and if it be large enough to permit of an examination of the fundus through it, two images of the disc may be seen at once, for the same reason that two images of an external object are formed upon the retina. It is asserted that congenitally displaced lenses are usually of subnormal size, but there is no decisive evidence on the point. A lens of this kind, recently removed by the writer from the anterior chamber of a boy aged 6, measured 7 mm. transversely, 4·75 mm. antero-posteriorly, and weighed 129 mgrms.

Dislocation into the anterior chamber is always noticed by the patient as producing marked and sudden impairment of vision—a high degree of myopia—and in some cases is very shortly followed by the onset of glaucomatous symptoms of a very severe character. Objectively, it gives rise to the peculiar appearance of a shining yellow circle, or golden ring, in the anterior chamber; this, like the dark line already described, is due to a total reflection of light at the edge of the lens. The lens may lie completely on the anterior surface of the iris, or it may remain more or less embraced by it. The pupil, and so much of the iris as is seen through the lens, are unusually magnified. If small and smooth, the lens may lie for a considerable time in the anterior chamber without causing pain or serious irritation, and it may from time to time, with changes in the position of the head, return to its original place behind the iris, and again fall forward through the pupil. In the case of the boy above referred to, it was possible at any time to bring the lens into the anterior chamber by giving the head a jerk. In eyes long blinded by iridocyclitis and other deep-seated changes, a degenerated and calcareous lens will sometimes fall forwards into the anterior chamber, and light up a fresh injection of the eye. Whether cataractous or clear, a lens remaining in the anterior chamber leads, sooner or later, to secondary opacity of the cornea and to ciliary injection.

Dislocation into the vitreous can be diagnosed only by means of the ophthalmoscope, or in some cases by focal illumination. The lens is seen lying in the lower part of the vitreous chamber, and oscillating from side to side with the movements of the eye. If the function of the retina be not lost, the best vision will be obtainable by means of a strong convex lens, as after cataract-extraction. Cases are on record of persons thus affected who could, by placing the face in the prone position, bring the crystalline into the pupillary region, and, for the time being, obtain excellent vision by that means. On the other hand, a lens lying unattached in the vitreous may, in consequence of such a prone position of the face, fall through into the anterior chamber, and at once set up serious symptoms. Lenses dislocated into the vitreous have been known to remain transparent for years, but their usual tendency is to become semi-opaque. In rare instances they gradually disappear, apparently by absorption.

Each of the three forms of displacement above described may arise as a direct result of injury. In such cases other symptoms, such as wound of the tunics, hæmorrhage into the chamber, or rupture of the iris or choroid, are usually present, and the eye frequently becomes glaucomatous. Secondary glaucoma, of very sudden and severe type, occurs also in some cases of spontaneous dislocation of the lens; the mode of its production deserves special consideration. A lens in the anterior chamber may form a complete barrier to the escape of the intraocular fluid from the eye. Under normal conditions, the stream which passes from the posterior to the anterior chamber on its way to the outlets in the neighbourhood of Schlemm's canal, raises the iris to an imperceptible extent from the surface of the lens, and meets with no resistance at the pupil; but when the lens lies in front of the iris, this same stream tends to press the iris against it, and, if once its passage through the pupil should be stopped, the accumulation which ensues in the posterior chamber drives the iris forwards still more forcibly, and, as the pressure rises, the blockade becomes more and more complete. The periphery of the iris, where not supported by the lens, is then driven forwards until the angle of the anterior chamber is closed by contact of the iris with the cornea. An intensely acute glaucoma may arise in this way simply through the spontaneous falling of the lens into the anterior chamber; and, what is still more remarkable, the glaucomatous tension may effect its own relief, by driving the iris forwards round the margin of the lens until the latter falls back again through the pupil, whereupon the filtration channels are reopened, and the glaucoma is at an end, until the accident occurs again. The glaucomatous complication occurs more readily when the lens is large than when it is small—in other words, it occurs more readily in the old than in the young. A lens dislocated laterally behind the iris may cause glaucoma by pressing against the ciliary processes at the side towards which it is displaced, and thus closing the angle of the anterior chamber throughout a considerable part of the circle. Cases in which a mechanical production of glaucoma by a dislocated lens in the way described was proved by dissection have been recorded by the writer (*Ophth. Rev.* vol. i. p. 209; vol. ii. p. 257).

Treatment.—A congenital partial displacement, so long as the lens remains transparent, admits of no satisfactory treatment beyond a correction of the refraction according to the indications already given. Should the lens become opaque, an attempt may be made to remove it, or the safer plan of making an iridectomy in the direction opposite to that of the displacement may be adopted. This gives an eccentric but clear pupil which, with the help of a cataract-glass, may permit of good vision. Should a congenitally displaced lens fall into the anterior chamber, it should, as a rule, be removed without delay. Possibly it may return spontaneously, once or twice, to its former position behind the iris; possibly it may be kept there a while by the persistent use of eserine; but temporising will in the end prove useless: it is best to remove the lens before inflammatory or glaucomatous complications are set up. It may be needled if the patient be young, or it may be extracted entire through a corneal incision of sufficient size. In order to prevent the lens from falling back through the pupil at the time of the operation, the iris should be well under the influence of eserine; but this should not be applied until shortly before the operation, for contraction of the pupil under these circumstances has been known to induce glaucoma in the way above referred to. If a sufficient support to the lens cannot be obtained in this way, it should be fixed with a needle passed through the cornea while the incision is made. It will escape through a suitable incision without traction. An escape of vitreous is inevitable. In cases of traumatic dislocation into the anterior chamber, immediate extraction of the lens may afford the only chance of saving the eye, especially if glaucoma be present, but it is hazardous. A lens lying in the vitreous can rarely be extracted with safety to the eye. In all cases of dislocation of the lens in which vision is already lost, and in which treatment is necessary, enucleation of the eye is the safest course.

PRIESTLEY SMITH.

CUPPING may be Wet or Dry. WET CUPPING is a method of blood-letting in which blood is taken from a number of small incisions by atmospheric pressure.

Situations suitable.—Any region which is smooth and fleshy; hence in fat persons a large number of parts are available. In emaciated subjects, the nape of the neck, loins, buttocks, &c.

Parts to be avoided.—Irregular surfaces of all kinds (e.g. over the intercostal spaces in the very thin), regions over sensitive organs—as the mamma, and the immediate neighbourhood of inflamed skin or cellular tissue.

Apparatus required.—Cupping-glasses of several sizes, scarificator, spirit lamp, hot water, sponge, and bleeding bowl. The *glasses* are bulbous in form, contracted at the mouths, which may be oval or circular; the latter are the easier to apply. The *scarificator* is a small machine fitted with a number of fine blades (from 3 to 12 in number), which can be withdrawn and suddenly projected, by a spring and trigger arrangement, from a flat plate which is applied to the surface of the skin. The knives can be set at any depth, and should be so adjusted as to cut through the '*cutis vera*' *only*, which varies in thickness in different situations.

Operation.—With a warm sponge moisten the selected spot, take the cupping-glass, which should have been lying in hot water, and *partially* exhaust the contained air by placing the flame of the spirit lamp in its interior; the lamp having been quickly withdrawn, place the mouth of the glass evenly on the part to be cupped, whereupon the soft tissues within the rim should swell and project towards the glass cavity. Several glasses may be applied side by side in this manner until a considerable area is covered, but care must be taken that they are not placed in *actual contact* with one another. After an interval of one minute, remove the glass by tilting it to one side, press the scarificator, already properly adjusted, on the swollen part, discharge the blades, remove it instantly and reapply the glass as quickly as possible in the same way as before. Blood should then flow from the cuts until the vacuum in the glass is destroyed. The flow having ceased, remove the glass with its contents, sponge the part with warm water, and, if necessary, apply another glass. As a rule not more than about two or three ounces will be obtainable from one application of the scarificator, which must never be applied in exactly the same place a second time at one cupping. After the operation, bleeding stops spontaneously, and a piece of strapping may be put over the wounds.

Caution.—If no blood follows the application of the glass after the use of the scarificator, one of the following causes will probably exist:—(1) Improper adjustment of the blades; if these cut *too superficially*, the vessels are not laid sufficiently freely open; if they cut *too deeply*, the subcutaneous fat is invaded and projects into the wounds, effectually plugging them. (2) Insufficient or complete exhaustion of the air in the glass. In the former case the vacuum is too slight to produce any material flow; in the latter the pressure on the parts under the rim is so great that the vessels are occluded.

In addition to the glasses already mentioned, others may be obtained which are fitted with an arrangement by which they are exhausted by means of a syringe, so that the spirit lamp is not needed; but they are not so effectual as the simpler form.

Dry Cupping.—A method, seldom useful in surgery, by which the congestion of deep structures is said to be relieved by causing a temporary determination of blood to the surface of the body by the application of cupping glasses in the manner described in the first stage of wet-cupping.

William H. Bennett.

CURVATURE OF THE SPINE.

See Antero-Posterior Spinal Curvature; Lateral Spinal Curvature; Caries of the Spine.

CUT-THROAT. *See* Throat.

CYLINDROMA. *See* Sarcoma.

CYNANCHE. *See* Pharynx; Tonsils.

CYPHOSIS. *See* Antero-posterior Spinal Curvature.

CYSTICERCUS CELLULOSÆ

—more properly known as the cysticercus telæ cellulosæ—is the cystic form of the tænia solium or common tapeworm; and, if we except a doubtful case of C. tenuicollis, is the only form of cysticercus known in the human body.

Cause.—One of the matured segments of a tapeworm, with its already developed embryos, has but to be swallowed to undergo further development. Located in the stomach of a pig it speedily bores its way into the tissues of its host, becomes encysted, constituting the condition which is known as measly pork, which condition is precisely analogous with the C. cellulosæ of man. According to Leuckart, the segments of the tapeworm need not pass into a second individual, but may infect the person who is already affected with tapeworm. The cysticercus may be found in one part only of the body, or may pervade the whole, as in a remarkable case recorded by Delore, in which over two thousand cysticerci were found after death. They were distributed all over the various tissues, from the brain to the skin, but had not contributed apparently in any way to produce death. The cysticercus is found most commonly in the connective tissues, with scarcely less frequency in the muscles, and more rarely in the various organs and in the skin. In a few cases it has appeared in the aqueous or vitreous chambers of the eye.

Diagnosis and Symptoms.—As a rule there are but few symptoms which will lead to correct diagnosis during life. Unless the cysts are in some superficial position, their very existence cannot be conjectured; indeed it is possible, as in Delore's case (*supra cit.*), that the whole body may be riddled with cysts without their presence being suspected. If they approach the surface, it is more than probable that their true nature will only be revealed by the aid of the surgeon's knife. In the brain they have been known to give rise to epileptiform, maniacal, and other obscure nervous symptoms, the true import of which could only be determined by a post-mortem. When the parasite makes its appearance in any part of the eye, it can as a rule be readily detected, at least by the aid of the ophthalmoscope. On this point our chief knowledge is derived from Von Graefe, who enjoyed considerable opportunities for studying the subject. He describes two kinds—the free and the encysted form—the former being probably due to the rupture of the cyst-wall, and having been seen, so far, only in the aqueous humour or lens capsule, whilst the encysted form grows in or behind the retina.

The *symptoms* to which such a cyst will give rise depend greatly upon its situation. In the deeper parts of the eye its presence is chiefly characterised by a gradually advancing blindness, leading in some cases to total disorganisation of the eye and permanent loss of vision.

If a suspicious cyst, whether situated in the eye or elsewhere, has been opened, its contents should be examined microscopically for hooklets. If enough of the fluid can be obtained, it should be tested for chlorides, which it contains in great excess. It rarely contains albumen. The specific gravity varies from 1,005 to 1,008 usually.

If the cyst comes away as a whole, the coiled-up worm should be looked for. The condition of the worm will vary with the age of the cyst.

Treatment.—Before discussing the question of treatment, it is of the greatest importance to bear in mind the natural term of existence of the cysticercus, after which it undergoes a gradual diminution in size, mainly owing to the absorption of its fluid and calcareous degeneration of its envelopes, which processes terminate its existence within eight months of its first appearance (Cobbold). Such being the natural process of cure, the prognosis is almost invariably good where a correct diagnosis has been made. If a cyst has been discovered in any obvious position, it can either be dissected out or freely opened and drained, or packed with lint and allowed to heal from the bottom. The situation must determine which mode of treatment is to be preferred. *See* Hydatids.

In the case of the eye, if the cyst is situated in the anterior chamber or lens, it admits of removal if necessary; but if placed in the vitreous, or attached to the choroid, no operative treatment is admissible, unless so much inflammation should chance to be set up as to make it advisable to remove the eyeball. Every operation that has been attempted for removal of the cysticercus from the vitreous humour has resulted in complete failure. W. Bruce Clarke.

CYSTIC TUMOURS.—As non-malignant growths, these tumours may consist of a cluster of cysts, or cysts may be interspersed in a solid matrix, or a cyst may have solid matter growing up within it, and thus more or less completely filling up its cavity. As to situation, they are found most commonly in the breast, the ovary, the thyroid gland, and the lower jaw.

Cause.—No cause peculiar to these tumours can be assigned for their occurrence.

Pathology.—Some of the cystic tumours of the ovary are seen to have arisen from a cluster of enlarged Graafian vesicles, which are again enclosed in a common capsule—that of the ovary. These cysts, as they enlarge, coalesce by the absorption of their common septa, and thus gradually merge into one or more large cysts. The evidence of these changes is seen in the numerous fenestræ, all having curved borders, which mark the inter-cystic communications. In other cystic tumours well-defined cysts may be seen scattered through or intertwined amongst solid growths, and are termed 'exogenous cystic tumours.'

In a third variety, termed 'endogenous tumours' or *proliferating cystoma*, the solid growths are attached to and spring up from some part of the walls of the various cysts, and may fill up and obliterate the cysts. The sero-cystic disease of the breast is a tumour of this character. The solid growth is composed of fibro-cellular elements, and not infrequently may be a spindle-celled 'sarcoma.'

Another variety of a mixed fluid and solid tumour occurs in the softening or cystiform degeneration of fibrous and other tumours, the result being that definite but not encapsuled collections of fluid are produced which may contain serum—pure, or mixed with blood—or a mucoid material. These changes are more prone to occur in malignant than in non-malignant tumours.

Diagnosis.—A cystic tumour grows to a large size without giving rise either to inflammation or ulceration. It is seen to be lobulated; the apparent lobules are the component cysts, which plainly fluctuate; the skin is often thinned in places. As a rule these tumours do not cause much suffering. When occurring in the breast, the nipple, if displaced, is not retracted, and the axillary glands, when affected, are generally simply enlarged, and not indurated.

Treatment.—Cystic tumours should be removed early and completely. If this proceeding is impossible, and the cysts are few and large, they may be tapped, and in rare instances treated successfully by iodine injections or by setons.

Alfred Willett.

CYSTINE or CYSTIC OXIDE. *See* Calculus, Urinary.

CYSTITIS. *See* Bladder, Diseases of the.

CYSTOCELE, a tumour formed by the prolapse of the bladder into the vagina. *See* Vagina, Affections of the.

CYSTOPLASTY. *See* Ectopia Vesicæ and Epispadias.

CYSTORRHŒA. *See* Bladder, Diseases of the.

CYSTS.—By the term 'cyst' is meant a collection of a fluid, non-inflammatory in its nature, which is contained in a single closed bag termed the 'sac.' A cyst, unless there is an occasional accidental discharge of its fluid contents, is a permanent and usually an increasing swelling, the contents of which, whilst varying in character as well as in consistency, are capable of complete evacuation when the cyst is laid open. There are two clear distinctions between cysts and cystic tumours, the first, that a cyst contains within it nothing of the nature of a new growth, and the second, that all the fluid in the tumour is contained in one sac. Hence the terms 'a cyst' and 'cystic' convey quite distinct ideas of the nature of any tumour.

The varieties of cysts are very numerous, not because the actual nature of the sac itself varies much, but because of the very varying nature of the origin and, still more so, of the contents of cysts. A source of confusion moreover exists, viz. that of fluid swellings having precisely the same nature pathologically, some may be regarded as cysts, i.e. tumours, whilst others never have these appellations given them. Cysts receive their distinctive names generally from the nature of the fluid contained within the sac, whilst they are classified according to the manner of their production. Thus cysts are styled serous, synovial, mucous, sanguineous, milk, salivary, oil, seminal, colloid, sebaceous, dermoid; whilst, when classified, they are described as exudation, retention, new-formation, congenital, and parasitic cysts. A brief explanation of the typical forms of these classified cysts is perhaps necessary, whilst any special description of the designated cysts can scarcely be required.

Exudation Cysts are formed by the distension of a pre-existent space, varieties of which are seen in the synovial cysts of chronic bursal effusion or of ganglia, and in the serous collections in tooth-sacs; whilst hydrocele of the tunica vaginalis—a swelling of this nature—is not called a cyst.

Retention Cysts are those in which the orifice of a duct from some cause closes up or is obstructed, so that the secretion being pent up accumulates and distends the duct forming a tumour, of which the ordinary sebaceous cyst in the skin, the mucous cyst of the lips and of the vagina, milk cysts of the breast, salivary cysts, such as ranula, and seminal cysts of encysted hydrocele, are illustrations.

The New-formation Cysts comprise instances of nearly all the named cysts, some of the more noteworthy being the large serous cysts found in the neck, under the name of hygroma—collections of fluid diffusing themselves widely, yet never becoming tense—thyroid gland cysts, mammary cysts—some of which evince no disposition to proliferate, as, on the contrary, do most of the ovarian cysts—and parovarian cysts of the broad ligament.

Under *Congenital Cysts* are placed, meningocele (somewhat erroneously), congenital cysts of the neck, dermoid cysts, so frequently found at some point around the orbits, and especially at the outer angles, and the ovarian dermoid cysts.

Amongst *Cysts of parasitic origin* the chief is the well-known hydatid cyst of the liver and elsewhere.

Pathology.—In a cyst, regard has to be paid to the investing membrane or sac, and the nature of the contents. The contents of most of the cysts being natural secretions, only such changes would occur as condensation or inflammation might effect. Of the sac, it has to be noted how greatly it varies in substance. In hygroma of the neck it is so thin and delicate as to be scarcely separable, whilst in some ovarian cysts it may be one-fourth of an inch in thickness. In serous cysts which have not been inflamed the lining membrane is smooth and glistening, whilst in others it has a rough and leathery appearance.

On its outer aspect, if placed in a serous cavity, a cyst will of course be covered by this membrane, but under other conditions it may be loosely invested with areolar tissue, or so intimately blended with the structure in which it has been developed that the sac cannot be detached. The intervening portion of cyst-wall consists mainly of fibrous tissue, with perhaps some tissue-elements indicative of the part in which the cyst has developed. Often, too, the configuration of the cyst may indicate the mode of its production, being either long and tapering or irregularly pouched.

Symptoms and Diagnosis.—The physical symptoms of a cyst might shortly be described as those of a chronic abscess, except that, as a rule, a cyst is more tense; hence, elasticity, fluctuation, or undulation become the symptoms most to be depended upon, as the cyst varies from a tense hard swelling to a soft flaccid one. Inasmuch, then, as the existence of fluid in a sac is seldom difficult to diagnose, and since the doubt, where it exists, as well as the nature of the fluid can be at once cleared up by an exploratory puncture with an aspirating needle, it is needless to lay stress on the diagnosis of cysts.

Treatment.—The mode of dealing with cysts is governed partly by their nature and partly by reference to the structure in which they are placed, or the organ with which they are associated.

The most effectual way of dealing with a cyst of moderate size which has no entangling connections, is to excise it, taking care, as a rule, to remove the cyst-wall. In others, such as milk cysts and most of the simple serous cysts, if a single tapping fails to cure, the better course is to lay open the sac and effect its cure by granulation; whilst the large cysts of the neck, after tapping and evacuation, may be injected with iodine. In a few cases, where pressure can be adequately employed, cysts may be cured by this means—of course, after evacuation of the contents. ALFRED WILLETT.

D

DACTYLITIS. — Inflammation of a finger, e.g. dactylitis syphilitica. *See* HAND, Surgery of the.

DALTONISM. *See* COLOUR-BLINDNESS.

DAVY'S LEVER.—This instrument, used by Mr. Richard Davy for compressing *per rectum* the aorta and the iliac arteries, consists of a straight and smooth cylinder of ebony from 18 to 22 inches in length, and with a maximum diameter of five-eighths of an inch. The rectal portion, which has a slightly bulbous extremity, is graduated to an inch scale, so that the length of cylinder passed into the rectum can always be readily determined. This is introduced into the rectum as far as the common iliac artery or the aorta, its projecting part being kept nearly parallel to the opposite thigh, and, when it is supposed that the vessel has been reached, the external arm of the lever is raised, the perineal tissues acting as a fulcrum. Compression of the artery by the rectal end of the lever is indicated by arrest of the pulsations of the femoral artery. This method of restraining hæmorrhage, though practised most frequently in cases of amputation at the hip-joint, has been advocated by Mr. Davy as applicable to any surgical procedure where it is desirable to check for a time the blood-current through the aorta or the iliac arteries. It has recently been applied with success in two cases of large traumatic aneurism of the gluteal artery treated by incision and double ligature. The most salient advantages of rectal compression by the lever are held to be, perfect control of the artery with a minimum amount of disturbance of the circulatory system. This instrument is certainly very useful in effecting temporary arrest of the circulation of the lower extremity, and has been applied with success in a long series of cases. It needs, however, to be applied by skilled hands and with much care, as, by the action of so long a lever, the intestine might be ruptured or serious injury done to the soft structures of the pelvis.

DEAFNESS, Diagnosis of.—Deafness is a blunting or abolition of the perception by the ear of the external world. This defect may arise in the sensorium itself, which is essentially the perceiver of sound, or in the sensory organ, which supplies to the brain the material which it transforms into a sensory perception. How this change of the physical into the physiological process is effected remains a mystery. How the collection and conduction of sonorous vibrations to the auditory sensorium are effected is, so far as surgical purposes are concerned, fairly well known, and it is with the integrity of the structures acting in these capacities that the surgeon will be required to deal.

The defect may be of such a slight character that it is not perceptible even to the patient himself, as in the cases where the range of audition is limited, or when it affects one ear only, and it has not been brought under his notice. Or it may be apparent under certain conditions only, as in cases affecting the accommodation of the ear, when it causes an inability to join in mixed conversation. In other cases the facultative loss is so great that it is apparent to all, and prevents the sufferer following the usual avocations of life, or enjoying the conversation of his fellow-beings. The cases which seek surgical aid are those in which an inconvenience is felt in the usual intercourse of life, and to these our examination will be confined.

How do we determine the degree of the defect complained of? Numerous methods have been proposed and are in use, but for practical purposes the watch, the tuning-fork, and the voice are sufficient.

The want of any index of the strength of the voice, when used as a test, prevents it being employed as a means of comparison with the observations of others, or even with the observation of the same surgeon at different times; and, although valuable in being the form of vibrations which the patient generally desires to hear best, and also in being a method which commands conclusive answers, it is much less exact than the tests by the watch and tuning-fork. As it, however, happens that there is no exact relation to be found between the ability for the hearing of speech and simple tones, and that it may increase for the one while it remains *in statu quo*, or even decreases, for the other, the voice ought to be employed by the surgeon in all cases, and more especially in those where the patient will be under observation upon different occasions by the same attendant.

In testing by speech a whisper is usually employed, and the patient, closing the opposite ear, and turning the ear to be experimented upon towards the speaker, is thus unable to assist himself by observing the motion of the lips, in repeating the words or answering the questions of the surgeon. The distance at which the patient recognises the words spoken is taken as the degree of hearing for that day. If single words be employed, care must be taken to use words containing vowels of similar tone and of equal familiarity on different occasions. The asking of several questions which have no connection with each other seems to be more practical, and as conclusive.

The acuteness of hearing is determined with the watch by causing the patient, with his eyes and opposite ear closed, to say at what moment he hears the tick of a watch brought gradually towards the ear under examination. The distance of the watch from the ear at that moment is noted, and is employed as the numerator of a fraction, the denominator of which is the number of inches at which the tick of the watch in use is heard by a normal ear. By this mode of noting the observation, a comparison can be made of the acuteness at different times and by different observers. When the patient cannot hear the watch unless it be in contact with, or pressed upon, the auricle, the numerator becomes $\frac{\mathrm{Co}}{}$ or $\frac{\mathrm{P}}{}$ respectively. A stop-watch is useful for verifying the statements of the observed, but, by noting repeatedly the distance at which the patient avers that he becomes cognisant of the watch-tick, the examination can be made with the usual watch. It must be remembered that in testing with a watch two particular notes only are employed, and therefore that the examination thereby is but a rough-and-ready way of giving a comparison of one ear with another.

Hitherto our examination has been confined to the acuteness of hearing of sonorous vibrations through the usual sound-conducting apparatus, while that through the cranial bones has not been in view. For determining the latter, a large tuning-fork of 512 vibrations in the second, with clamps grasping the prongs in order to destroy the harmonics of the fundamental tone, is the most convenient. But should that not be at hand, the watch will give a rough general estimate thereof, by placing the watch on different points of the head and making a comparison of the position of the cranium at which a weak watch-tick is lost, with the point on the observer's head at which the same occurs.

When a fork is employed, the examination is conducted as follows:—After causing it to vibrate, the handle is placed on some part of the patient's head, usually the mastoid process, and the number of seconds noted during which the sound can be recognised by the observer's normal ear, after the patient has ceased to hear it. This recognition may be effected in two ways, viz., by placing the fork on the mastoid, or close to the concha of the observer. The former is the usual mode, and of it we shall speak. The number of seconds from the cessation on the patient's mastoid to its cessation on the observer's, gives the loss compared with the normal ear. For example, if the observer finds that he hears through his mastoid the fork-vibrations for ten seconds after the patient has ceased to recognise them through his mastoid, the loss is noted as 'acoustic p. mastoid—10″,' and if the ages of the patient and practitioner are nearly the same, the loss is assigned to the parts beyond the conducting apparatus, but not excluding affections thereof. Should the fork not be heard by the observer on its transference to his mastoid, the acuteness is reckoned normal, unless there are obstructions in the meatus or cavity sufficient to reflect the vibrations passing outwards, and so reinforce those acting on the inner ear. But, for practical purposes, the acoustic may be recognised as normal.

In using the tuning-fork for the determination of the acuteness of hearing aerially-conducted vibrations the loss is determined in the same way as on the mastoid, care being taken to place the fork in the same position in relation to both the observed and observer's ears. It would further the diagnosis of such affections if a standard fork could be settled upon, which we could use as the denominator, as we do in the case of the watch.

It will be simple from the above methods to fairly apportion to its proper seat the cause of deafness. No affections, however severe, of the external or middle ear which are conducting apparatus alone, will prevent the recognition of sonorous vibrations sufficiently loud to be perceived by a healthy acoustic nerve through the mastoid, from reaching the internal ear of the patient through that bone. No such vibrations, however well conducted, either through the meatus or through the mastoid, can arouse an acoustic whose function is in abeyance. If a watch be heard at what has been determined to be its normal distance, the acuteness of hearing, for that note, may be taken as normal. If a fork be heard as long on the mastoid of the patient as on the mastoid of a normal ear, the internal ear may, for that note, be taken as fairly healthy. If the fork be heard to the natural extent or exceed it on the mastoid, but neither it nor the watch reach the standard determined for aerially-conducted vibrations, an affection of the external or middle ear is diagnosed. If the watch be not heard at its proper standard of distance, nor the fork to its proper extent through the mastoid, the apportioning of the amount of the defect to the external and middle ear, and to the internal ear, may be roughly made by the examination of the structures, and by noting the loss of vibrations conducted by the meatus after their perosseal recognition has ceased. Thus, if a fork, the vibrations of which are heard at the concha thirty seconds after they have ceased to be recognised on the mastoid, is heard by the patient five seconds less on the mastoid, and only ten seconds at the concha, the loss is marked as five seconds and twenty seconds respectively.

W. Laidlaw Purves.

DECUBITUS. *See* Bedsores.

DEFORMITIES, Congenital. *See* Club-Foot; Hare-Lip, &c.

DELHI BOIL or SORE.—This disease first attracted attention by its great prevalence among the British troops stationed in the city of Delhi after the mutiny of 1857. Before the mutiny the troops were garrisoned in a cantonment situated outside the city walls, and they appear there to have enjoyed an immunity from these sores. In the year 1864 as many as from forty to seventy per cent. of the men suffered from them; and the Government of India appointed a commission, of which Dr. John Murray, Inspector-General of Hospitals, was president, to investigate the nature and cause, and advise as to the prevention and cure, of this troublesome complaint. The commission submitted a long and interesting report. They found that the disease was not dependent on poverty or malaria, and that it was inoculable; associated it with the filthy state of the city, more especially with the use of impure water drawn from foul wells; and recommended sanitary improvements and the supply of river or canal water to the troops for all purposes.

Much interesting information on this and allied subjects will be found in the late Dr. Tilbury Fox's work on *Diseases of the Skin*, and in a volume published by Drs. Tilbury Fox and Farquhar in 1876, under the sanction of the Secretary of State for India, *On Certain Endemic Skin and other Diseases.*

It has been established, by the observations and researches contained in these reports and publications, that the disease known as Delhi boil or Delhi sore is by no means confined to the town of Delhi and the neighbouring villages, but prevails in other parts of Northern India.

A similar disease has been observed and described by Colville, Wortabet, and others as existing in Syria and Turkish Arabia, more particularly in the towns of Aleppo, Bagdad, and Bussorah, and other localities situated in the land of Mesopotamia—the valley of the rivers Tigris and Euphrates. It is known in these parts as the Aleppo Evil, Date Mark, and the Bouton d'Alep. The same disease has been met with at Aden. An affection apparently identical with the Indian and Arabian sores has been observed in Egypt, Morocco, and Algeria. Finally, Dr. Vandyke Carter discovered a disease which he considers to be the same as the Algerian and Syrian maladies in the island of Candia, where it has the name of Caneotica (from Canea, the capital town of the island), Bouton de Crete, Lib-lib, &c. He has carefully studied, described, and figured the sores of Algeria, Crete, and Aleppo, and advances the opinion that there is an 'essential bond of connection between the maladies of Biskra, Crete, Bagdad, Aden, Scind, and Delhi.'

Causes.—The disease is endemic, and has a very definite geography. Its causes must therefore consist in conditions and circumstances common to the localities in which it is met with. What these are has not been clearly ascertained. It prevails in towns and crowded centres of population rather than in hamlets and sparsely inhabited villages. In these its homes it attacks all classes, both sexes, and all ages indiscriminately, but seems to have a preference for new-comers and young children. It does not seem to depend on climate, for then it would be more generally distributed in town and country; but climatic conditions may, and probably do, combine with local conditions to produce it. These latter appear to be, or to be closely associated with, filth. The disease has almost disappeared from Delhi in consequence of sanitary improvements and improved water-supply (see *Report on Sanitary Measures in India in* 1873–74, and Drs. Lewis and Cunningham's report), and it lingered longer among the native troops and the native inhabitants of Delhi, who continued to draw their water from wells, than among European troops for whom river-water was provided. The well-water of Delhi has been found to be very impure, exceedingly hard, and to contain large quantities of nitrates and nitrites. The water of Biskra is also said to have been extremely impure; but here also a similar effect has followed similar changes in sanitation. In Aleppo and Bagdad the disease is ascribed to the use of impure river-water, and those resorting to clean wells are said to remain free from it. In Algeria the disease presents a marked seasonal character, attacks being most common in November and December; but in other places this feature is not so well marked. Occasionally, according to Carter, Aleppo Evil presents an epidemic character; and there is strong evidence that it was imported into Candia in the year 1827 by Turkish troops from Aleppo and Damascus who were sent to quell an insurrection in the island. It took root in Canea, and spread thence to other places. The sore is undoubtedly inoculable; this has been proved by experiment in India and Algeria, and the Jews of Bagdad practise inoculation of children. The disease is not contagious in the ordinary sense, but it seems to be communicable in a manner not yet determined. Nor does it appear to be hereditary. One attack is not protective from subsequent attacks, but repeated attacks are not the rule, and old residents appear to enjoy comparative immunity. Dogs and horses are said to contract the disease. What the intimate or immediate cause of the disease is has not been discovered. It has been ascribed to depraved nutrition of the body due to climatic influences, and considered to be 'a local manifestation of a cachectic condition due to residence in unhealthy localities' (Tilbury Fox); but these sores attack persons to all appearance in good health, and in other than endemic localities, where people also manifest climatic cachexia, they are not known. The fact that the most exposed parts of the body—arms and hands, face and legs—are those most liable to attack, points to a local causation. The disease has been attributed to the entrance of parasites through the pores of the skin and to poisonous material conveyed by mosquitoes and flies; but of these views no positive proof has been advanced.

Pathology.—In the language of modern pathology the disease belongs to the category of infective granulomata. Drs. Lewis and Cunningham found, as a result of very careful study, that its microscopic characters were identical with those of lupus as described by Virchow and others, and Carter's descriptions and plates support this view, which is also that of Geber, who investigated the Aleppo button. The skin is found to be infiltrated with lymphoid cells, which are found more abundantly near the vessels, glands, and lymphatics, and, gradually increasing in number, supplant the elements of the tissue. The features of the disease depend on the number and fate of these cells. Among them, miliary particles of an epithelial character and origin are found, some of them being altered hair-bulbs and impacted gland-ducts. The disease consists, in fact, of a conversion of the true skin into granulation-tissue, the epithelium being first increased and then shed, and the disintegration of the cells giving rise to breach of surface, which is eventually repaired by a process of granulation and cicatrisation. The cells appear to possess infective properties, but no structure of a parasitic kind has as yet been discovered in the morbid tissue. The new structure has a definite lifetime, and if the surrounding parts possess sufficient vital resistance limitation takes place and repair ensues. If the vital resistance is weak, from general ill-health, limitation does not occur so soon or so completely; new areas of skin are invaded, and the disease spreads in the manner indicated by the term 'serpiginous.'

Symptoms and diagnosis.—The disease in a well-marked case presents several phases or stages, which may be called the stages of (1) infiltration, (2) ulceration and incrustation, and (3) repair. It commences as a small, hard, itchy papule or pimple resembling a mosquito-bite. A few dilated vessels may be seen converging to the centre of this spot, which presently enlarges and becomes smooth, raised, dusky, and shining. Ridges of smooth swollen skin radiate from this elevation, or new spots appear in its vicinity. The affected area pits on pressure, and a stinging sensation is experienced on touching it. The hair-bulbs are specially involved, and present the appearance of minute, yellowish points in the glazed, dusky, red material. Presently the epithelium is shed; a viscid ichor exudes from the surface, which becomes covered by a crust. As the disease extends the crust enlarges, and at the centre breach of surface takes place, and pus and disintegrated tissue assist in forming the crust, which may exhibit cracks emitting a sanious or puriform fluid. On removal of the crust an ulcer is revealed, with hard edges and a red, flabby, irregular surface, covered with fungoid granulations that bleed freely. Eventually cicatrisation commences at the centre and proceeds towards the circumference. The outer infiltrated ring of the sore undergoes resolution, and a smooth, depressed, reddish-brown cicatrix, with sharp edges, remains. No contraction results from the loss of tissue, which does not involve the subcutaneous areolar structure. This is a description of a typical case; but in mild instances of the disease no breach of surface or ulceration occurs, the granulation material undergoing in part disintegration and in part organisation into cicatricial tissue. In other cases the process is complicated by suppuration, a small, deep, punched-out abscess forming in the centre and giving rise to a hollow ulcer, or these ulcers may be multiple. In other cases the course of the disease may be materially modified by the application of caustics and irritating agents.

The progress of the disease is slow and protracted, and occupies from six to twelve months from first to last. The parts of the body most commonly attacked are the forearms—the back and ulnar aspect by preference—the wrist and front of the forearm, the elbows, the hands, the neck and face, the knees, legs, and feet. The trunk is very rarely affected. Persons arriving at a place where the disease is endemic do not contract it for several months, and the sore may appear many months after leaving the locality, so that there would seem to be a long period of incubation. The neighbouring glands are not affected except when the sore is irritated, and there is no indication of any constitutional change accompanying the local disease.

The diagnosis is not difficult. Residence in a locality where the disease is known to prevail, and careful study of the features of the sore as above described, suffice to distinguish it from any other cutaneous disease except lupus, with which many competent authorities consider it identical. Spreading serpiginous ulcerations sometimes appear on the genitals and groins as a result of chancroid which present features somewhat resembling the Oriental sore; but these are generally more extensive and protracted, and show little or no disposition to undergo spontaneous cure. The locality of these ulcers, and the absence of a history of residence in a place where the sore is endemic, aid in establishing a distinction. The only other affections for which this sore might be mistaken are the syphilitic and pseudo-syphilitic granulomata, such as the frambœsia of the West Indies and the Parangi disease of Ceylon; but the eruption in these cases is more extensive, the severity of the disease greater, and constitutional cachexia more apt to accompany it. It only remains to add that, in its endemic haunts, ordinary wounds, scratches, or abrasions may take on the features of the specific sore.

Treatment.—The best *preventive* treatment is obviously removal from the locality where the sore is endemic. Next to that, attention to general sanitation, and more especially the use of pure water, appear, from the evidence above referred to, to exercise a decided influence over the prevalence and development of the disease. As regards local or curative treatment, destruction of the indurated papule or tubercle in its early stages, by means of caustics, is allowed, by all who have had an opportunity of testing it, to be a thoroughly effective means of stopping its progress and minimising suffering and loss of tissue. Various agents have been employed for this purpose—principally nitric and carbolic acids, potassa fusa and strong liquor potassæ, and nitrate of silver. A preliminary incision has been recommended, to admit of readier access of the caustic to the doomed tissue. Even after ulceration has been established, the destructive treatment is considered by some authorities the best, as saving time and tissue. Care must be taken, however, in the later stages that the cure is not worse than the disease. Scraping away the neoplasm with Volkmann's sharp spoon, or the cautious use of chloride of zinc paste, would be preferable to the stronger caustics in this stage. Irritating and stimulating applications of all kinds, such as the tinctures of iodine and iron, preparations of zinc, copper, and mercury, have been used without effect. They probably do more harm than good by weakening the vital resistance of the surrounding tissues. Soothing poultices, lotions, and ointments have also been employed, with more sense and success. It is very important, by means of tonics and diet, to improve the general health and intensify the vital resistance of the organism generally, and of the tissues adjoining the sore specially. K. McLeod.

DELIRIUM TREMENS may come under the notice of the surgeon as an independent complaint; but the cases dealt with in this article are those in which the symptoms supervene upon, and are the consequence of, a surgical injury, occurring in a person suffering from the effects of alcoholic excess. It is a well-known fact that intemperate individuals are unfavourable subjects for any injury or operation, and one direction in which this is revealed is in their liability to delirium tremens. In the writer's experience at the Liverpool Northern Hospital the symptoms did not come on in persons who were injured while drunk, but rather in those who were habitually intemperate, but by no means always to such an extent that they became intoxicated. Indeed, in some instances the patients would strenuously resent the charge that they were intemperate, because they were never drunk, and never lost a day's work. The kind of injury which is followed by delirium tremens varies, and it may be in itself of no danger, or even very trivial, such as a simple fracture or sprain, or a superficial wound. How far the suddenly enforced abstinence from alcoholic drinks may account for the development of delirium tremens is a matter of dispute; but there does not appear to be any real danger from this cause if the patient is properly supported in other ways. In some instances bad living, anxiety, injurious habits—such as excessive smoking—or previous illness, act as predisposing causes.

Symptoms and Diagnosis.—The more characteristic symptoms of delirium tremens may set in, in surgical cases, either rapidly and without any warning, or more gradually, being preceded by premonitory symptoms, such as disturbed sleep or sleeplessness; restlessness and tremulousness; mental agitation and confusion, with lowness of spirits and foreboding of ill; anorexia and disorder of the alimentary canal, with foul tremulous tongue and offensive breath; a quick but soft and compressible pulse; and more or less free perspiration. The actual symptoms usually appear within three or four days from the date of the injury, and often supervene during the night. The more striking of these symptoms, connected with the nervous system, may be summed up as absolute sleeplessness; mental disorder, with a peculiar form of delirium; and marked muscular trembling, combined with restlessness. The mental condition is one of mingled confusion, excitement and agitation, irritability, sense of dread, and suspicion. The delirium is usually of a busy character, and attended with various delusions, illusions, and hallucinations, of a strange and often horrible nature, which are generally transient and changeable, but occasionally fixed. Thus, the patient fancies he sees hideous objects, hears strange sounds, or feels insects crawling over him. He has an anxious, wandering expression, and is suspicious and distrustful of all who come near him. It may be possible to attract his attention for a moment, so that he will answer a question or do some act which is requested, but he speedily wanders off again. His own ideas prompt him to perform various actions, but there is an evident want of control, with unsteadiness of purpose. In some cases the delirium is of a violent character, and the patient tries to injure himself or others, or to tear the dressings off wounds or the splints off fractures. In other instances it either is from the first, or very speedily becomes, of a low and muttering type. There is marked trembling, which is especially evident in the hands and tongue.

There is usually little or no fever, but the patient is bathed in perspiration, while the pulse continues rapid and wanting in tone. In bad cases it may become dicrotic, as revealed by the sphygmograph. Occasionally marked pyrexia is observed, and the temperature may reach a considerable height. If the patient is violent, he becomes much exhausted after the fits of exertion. Should the symptoms not abate, and sleep be obtained, the tendency is towards rapid prostration and adynamia, and the patient dies from exhaustion or in a comatose state. Complications, especially pneumonia, may also supervene and hasten the fatal issue.

Delirium tremens, in surgical cases, has to be diagnosed from traumatic delirium which is independent of alcoholic excess; and from acute inflammation of the brain or its membranes. Attention to the history and symptoms will generally render the diagnosis sufficiently clear.

Treatment.—The treatment of cases of delirium tremens in surgical practice must be conducted on similar principles to those which are adopted in other cases. General management is highly important. The patient must be kept as quiet as possible, undisturbed by friends or others; at the same time being constantly watched by a competent nurse, one who combines the necessary firmness of purpose with gentleness of manner. He should, as much as possible, be humoured and influenced judiciously, without being opposed or physically coerced. Special care must be taken to prevent him from injuring himself, and for this purpose two or more attendants may be necessary. It is only in violent cases, where the proper amount of help cannot be obtained, that restraint by means of the strait-waistcoat is admissible; but still it may be imperatively demanded under such circumstances, otherwise the patient may convert a simple injury into a very serious one.

Attention to diet is another most important indication. A free supply of nutritious, easily assimilated, liquid articles of food is demanded, to be administered at frequent intervals, by night as well as by day. They may be previously digested by the peptonising agents now in use. Not uncommonly it is a difficult matter to get patients to take food, but much may be done by judicious coaxing. If, however, the difficulty is great, nutrient enemata, with some digestant, must be employed at regular intervals. As regards stimulants, whether they should be given or not, and in what quantities, must be determined by the circumstances of each case, and this matter always requires careful consideration. In many instances undoubtedly no stimulant should be given; but in others of a low type, or attended with much exhaustion, some kind of stimulant must be allowed, and it has been recommended to give that one to which the patient is accustomed. There are, moreover, other circumstances affecting surgical cases which may determine the question of the use of stimulants, apart from the delirium.

With regard to the use of medicines, these are often required in order to procure sleep and calm the cerebral excitement, but they must be given with due caution. In surgical cases the subcutaneous injection of morphia (gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$), is the best remedy to employ as a rule, repeated at more or less frequent intervals according to circumstances. Opium in a solid form, or the tincture; chloral hydrate (gr. xx.—xl.), and bromides, are also useful agents. Chloral hydrate and a bromide together form a valuable combination. How far it is desirable to push drugs of this class must depend upon the circumstances of each case, and their administration needs constant watching. It may be an imperative necessity to compel sleep at any risk, and in one case which came under his notice the writer believes that the attainment of this object, by the use of large doses of morphia, was the means of saving the patient's life. Chloroform may be serviceable as a temporary aid, in relieving violent excitement, enabling some surgical procedure to be carried on, or an enema to be administered. Among other medicinal agents recommended under certain circumstances, may be mentioned tincture of digitalis in full doses, tartar emetic (when there is much excitement), and capsicum.

The bowels should be opened from time to time by the aid of a saline purgative. Should adynamic symptoms set in, ammonia with bark and ether, and similar remedies, may be administered.

Frederick T. Roberts.

DE MORGAN'S SPLINT, for fracture of the thigh, is a long splint, which is applied to the sound side of the body, and which reaches from the axilla to well beyond the foot; from its lower end a crossbar passes at right angles towards the other foot. An extension apparatus is fixed to the injured limb, and the cord connected with it passes first longitudinally to the extremity of the crossbar, where there is a pulley, round which it passes to a second pulley at the end of the long splint, and thence up the outer side of the latter to an elastic accumulator, by means of which the proper amount of extension can be given to the limb.

Bilton Pollard.

DENTIGEROUS CYSTS.—The development of *cysts* in connection with uncut teeth is a subject of great practical importance to the surgeon, since mistakes in the diagnosis and treatment of these cases are far from rare.

Dentigerous cysts may occur in either jaw, a tumour being gradually formed, the growth of which is slow, and for the most part painless.

A careful examination of the neighbouring teeth will be the best guide to a correct diagnosis, for if a tooth be absent, or if, as sometimes happens, a temporary tooth occupy the position of a permanent one, the tumour in all probability is a dentigerous cyst, and no mutilating operation should be undertaken without first opening up the tumour to discover its nature.

Dentigerous cysts arise in connexion with teeth which, from some cause, have remained within the jaw, and have undergone a certain amount of irritation. They are most commonly connected with the permanent teeth; though the writer has met with a cyst in a boy of four, in whom a temporary canine tooth was wanting, and on cutting into the cyst, extracted seven small irregular nodules of dentine and enamel. Frequently the tooth in fault is inverted, but often there is nothing to explain the formation of the cyst, which is apparently due to an increase in the quantity of the small amount of fluid ordinarily found in the tooth-sac, after the completion of the development of the enamel.

The cyst-wall is usually too dense to give rise to the crackling so characteristic of the presence of fluid within, and is lined by a thick vascular membrane. Usually the tooth projects through this membrane; but a case has been met with in which a large cyst of the lower jaw was carefully searched in vain for a tooth, which, however, made its appearance some weeks after, when the membrane had been to a great extent destroyed by suppuration. Dentigerous cysts have been mistaken for solid growths on many occasions, one of the most remarkable specimens of the kind being one side of the lower jaw, removed from a girl of thirteen, in error, by the late Mr. Fearn, and now in the museum of the Royal College of Surgeons of England. Here the two plates of the lower jaw are expanded from the angle on the left to beyond the symphysis on the right side, forming a bony cyst, the cavity of which is lined with a thick vascular membrane, through which a well-formed permanent canine tooth projects.

The *treatment* of these cases of dentigerous cyst is sufficiently simple, when once a diagnosis has been made by an exploratory puncture. The removal of a portion of the cyst-wall, so as to allow of a search for, and the removal of, the hidden tooth is all that is necessary, the cyst-wall rapidly falling in so soon as a free vent for the contained fluid is secured.

Occasionally the contents of these cysts have suppurated before being opened, and in all cases care should be taken to use antiseptic lotions, and to ensure cleanliness by syringing. Cysts in connexion with fully-developed teeth undoubtedly occur, although possibly some of the so-called cysts are nothing more than abscess-sacs, which follow the fangs to which they are attached when extracted. *See* ANTRUM, Diseases of the. CHRISTOPHER HEATH.

DENTITION.—Writers on the diseases of children have been accustomed to lay at the door of teething a great variety of ailments, ranging from minor disturbances of the digestive tract to convulsions and marasmus. Why a normal developmental process should be so often a pathological one has puzzled many more recent authorities, and there is a growing disbelief in the ill-effects of 'teething.' So far as surgical treatment goes, it is limited to the lancing of the gums, which, if done at all, should be done freely, the tense gum being divided by a linear incision in the case of incisors and by a crucial incision in the case of molars. This will relieve some degree of worry and discomfort, if it does no more. Of more interest to the surgeon are the deformities of the teeth induced by constitutional conditions during the period of formation of the permanent teeth, which commences nearly coincidently with the time of birth. Congenital syphilis has been shown to induce a stunting of the first-formed portions of the teeth, so that the tips are contracted in all dimensions, whilst the bases of the crowns, formed later, are of normal size. Thus the incisors come to be peg-shaped, with a semi-lunar notch from side to side; the canines short and contracted at their points; and the first permanent molars have stunted cusps, the second and third molars being better formed, as their calcification does not commence till a later period.

Teeth with craggy honeycombed enamel are believed by Mr. Hutchinson to owe their deformity to the administration of mercury in infancy; it is certain that they are often found in children who have suffered from convulsions, but it is not fully established that they may not arise in any ill-nourished child independently of mercury, or of any form of stomatitis. CHARLES TOMES.

DESAULT'S LONG SPLINT for the thigh differs from that of LISTON in having a footpiece for the outer side of the foot in place of the notched extremity of the latter splint; it is also slightly hollowed, so as to fit the limb more comfortably, and it increases in width gradually from the footpiece to the upper end. The foot is attached to the footpiece, and counter-extension is maintained by means of a perineal band fixed to a notch at the upper end of the splint. The spica and body bandages are applied as usual. BILTON POLLARD.

DIABETES. — Certain surgical disorders occur in the course of diabetes with sufficient frequency and regularity to entitle them to be considered, not merely as accidental complications, but as in causal connection with it, or in some way or other dependent on it. They may be either purely functional or inflammatory, the general nutrition being so much impaired that the tissues break down into pus, or even slough and become gangrenous under altogether exceptional causes. The pruritus that is so exceedingly common, especially in the later stages, is an example of the first of these. All through the course of diabetes the skin is dry and harsh (like the dryness of the mouth and fauces, probably from purely physical reasons), very often scurfy and irritable; in the neighbourhood of the genital organs, especially of the female, this is so marked and so frequent that in all cases of severe pruritus it is necessary to examine the urine for sugar.

Boils and carbuncles are instances of the latter class. These affections stand in some peculiar relation to diabetes, for cases have been recorded in which, while suffering from an outbreak, otherwise healthy persons have passed considerable quantities of sugar in their urine. Boils occur most often in the earlier stages, and may come out in successive crops for a long period; carbuncles rarely till the disease is far advanced, and then the prognosis becomes exceedingly grave. Chronic urticaria, psoriasis, impetigo (Kaposi), and paronychia have also been observed, but not with the same regularity.

Affections of the eye are not rare. Diabetic cataract, arising from the defective nutrition of the lens, has long been known. Unless the case is severe it does not, as a rule, make its appearance until late in the course of the disease, so that operation for it, though sometimes successful, is seldom attempted. One eye is usually attacked first, and then later the second becomes involved, but it is rare for it to be complete in both long before the patient's death. Amblyopia, either temporary and recurring, varying in its degree with the progress of the general symptoms, or permanent and rapidly becoming worse, is probably dependent on a similar impairment in nutrition of the retina, and the paresis of the muscles of accommodation that is met with occasionally is probably to be explained in the same general way. In one or two instances hæmorrhagic retinitis independently of albuminuria has been observed.

Gangrene of exposed parts and of the extremities, resembling the ordinary senile form but more rapid in its action and always moist, accompanied by sloughing inflammation, is not uncommon as the immediate cause of the fatal issue in diabetes. The circulation is so feeble, the character of the blood so profoundly altered, and the vital energy of the tissues so depressed, that the slightest injury, especially of the foot, may suffice to induce it. For fear of this, from the extreme susceptibility to shock and the great tendency to secondary hæmorrhage, operations, unless absolutely essential, are rarely undertaken in diabetic patients. All wounds, even slight injuries, are repaired with great difficulty and are very prone to slough.

Glycosuria, sometimes only transient, sometimes permanent and indistinguishable from diabetes, is an occasional sequela of injuries. The former is not uncommon after prolonged narcosis, and may probably be attributed to the derangement of the circulation or the action of vasomotor nerves; the latter is more rare and difficult of explanation. Injuries of the head, general concussion of the whole body, or of the spine alone, afford the best known examples, but it has also been observed after blows on the abdomen, or over the kidneys, fractures of vertebræ, violent and prolonged muscular exertion, and even after burns; sometimes setting in within a few hours, sometimes only first noticed after months. Brown-Séquard is of opinion that under these conditions it must be of reflex origin.

C. MANSELL MOULLIN.

DIAPHRAGMATIC HERNIA. — This form of rupture possesses little practical interest. Out of 250 cases collected by Leichtenstern, the condition was diagnosed in 5 only. Even when diagnosed, the hernia is not amenable to treatment. Two general forms are described. In one the viscus that is protruded through the diaphragm from the abdomen into the thorax is contained in a sac formed either by the peritoneum or pleura, or by both. This is the true hernia. In the other there is simply a hole or rent in the diaphragm, and no sac. This is the false hernia. The false is more common than the true, in the proportion of 10 to 1. Some of the herniæ are congenital, and depend upon arrest of fœtal development, whereby the partition between the thorax and abdomen is imperfectly formed. Others are acquired, and depend mainly upon injuries that lacerate the diaphragm, such as stabs, gun-shot wounds, fractures of ribs. The acquired forms are much more common than the congenital. The hernia is more often on the left side than the right, in the proportion of 5 to 1. The abnormal aperture is more often in the muscular that in the tendinous parts of the diaphragm. Herniæ not infrequently occur through a gap close to the xiphoid cartilage, and between the costal and sternal portions of the diaphragm. The rupture has passed through the œsophageal opening, but never through that for the aorta or the vena cava.

The contents are most often the stomach, then the tranverse colon, then the small intestines. Next in order of frequency come the spleen, liver, pancreas, and kidneys (Leichtenstern). The hernia may cause no symptoms, or it may end fatally almost directly after its formation, or it may pass into a chronic state, giving only occasional trouble. The affection is very difficult to diagnose. In marked cases there is prominence of one half of the chest, a displacement of the heart to the right side, a tympanitic area in the thorax, with an absence there of respiratory sounds and vocal fremitus. There is pain in the chest and abdomen, together with attacks of dyspnœa, especially after eating or straining, constipation, dyspepsia, &c.

FREDERICK TREVES.

DIGITAL COMPRESSION. *See* ANEURISM; FEMORAL ANEURISM.

DIPHTHERIA OF WOUNDS.—True diphtheria of wounds is a very rare affection. The skin is far less liable than mucous membrane to the disease, and, when covered by normal epidermis, is never attacked. Slight excoriations of skin, leech-bites, &c., are most liable, but granulating surfaces are not exempt. Direct contact may produce it; e.g. the introduction of a cut finger into the throat of a child with diphtheria has led to the local development of diphtheria, attended by severe constitutional symptoms, and followed by paralysis. In rare cases, the disease has attacked excoriations, or skin-lesions such as favus, by infection, has led to diphtheria of the air-passages, and has been communicated to others with fatal results. The local process strongly resembles the disease miscalled 'hospital' gangrene, and is usually associated with phagedæna; but, strangely enough, tracheotomy wounds do not seem to be attacked.

Symptoms.—The skin attacked becomes red and swollen; an infiltrated, highly inflammatory area extends around, and serous fetid discharge escapes. The edges of the wound are raised up; vesicles form around the margin, break with discharge of fetid serum, coalesce, and develop into fresh sores. The surface is covered with thick, membranous, semi-transparent rinds like wet washleather, which adhere deeply but can be peeled off, though they are rapidly reproduced. The infiltrated tissues break down in shreds, but the sloughing does not usually extend to any great depth. The history of a possible contagion or infection will confirm the diagnosis.

Treatment.—The local treatment consists in peeling or scraping off the rinds, and then applying caustics. Solid caustics are usually best, such as potassa fusa diluted to half its strength with caustic lime, applied freely to the base and edges of the wound; but constant irrigation, which must be persisted in for a considerable period, answers well at times. Acid nitrate of mercury in solution, or strong tincture of iodine, has been used with benefit. The freest ventilation should be accorded, some stimulants, and the most nourishing diet possible. Salicylated cotton-wool should replace sponges, and be burnt, with all dressings, directly after use. Every precaution must be taken to prevent infection of mucous membrane, especially of the mouth, from the wound. Conversely, it must be remembered that in diphtheritic cases excoriations of the skin, and especially blisters, are liable to be attacked.

A more common, but still rare (in this country), affection of wounds resembles the above in its local symptoms, but is unconnected with true diphtheria, and will not give rise to it. It attacks the same class of lesions, especially granulating surfaces. A buff-coloured exudation covers the wound like a rind: it may be peeled off easily, and the raw surface, if treated with a stick of nitrate of silver or tincture of iodine, will usually soon heal. The local disease may remain long stationary or spread extensively, but it remains local. The granulations may slough, and then the condition simulates true diphtheria of wounds. If there is doubt about the diagnosis, it should be regarded as the severer form. The local treatment would be the same.

C. T. Dent.

DIRECTORS are blunt instruments, grooved to allow a bistoury to pass along them, and thus ensure an incision being made in the right direction. A steel director is useful for dissection among veins, as in tying the subclavian artery, but should never be employed where an artery is superficial and can be readily exposed with the scalpel. A German-silver director, especially if probe-pointed, is valuable in operating for fistula in ano, because it can be curved as required. A broad steel director is often employed in dividing the stricture of a strangulated hernia.

DISLOCATIONS.—A dislocation is a displacement of the articular surface of a bone from the position it normally occupies in a joint. Such displacement is rendered possible by giving way of the ligaments which maintain the bones in apposition, and it is frequently associated with laceration of muscles and contusion of the soft parts in the vicinity. When the injury producing the dislocation is severe, other complications may be present, such as paralysis from pressure upon, or rupture of, large nerve-trunks, and tearing of the main artery or vein of the limb. Proportionately, however, to the number of dislocations, such complications are very infrequent. Some dislocations, as those of the ankle and elbow, are not uncommonly associated with fracture of bone, whilst others, as those of the hip and shoulder, are very rarely complicated with fracture.

Dislocations are divided according to their origin into *congenital*, *pathological*, and *traumatic*.

Congenital dislocations are met with at birth, and the mode in which they are produced is a matter of conjecture. *See* Congenital Dislocations.

Pathological dislocations are such as follow disease or inflammation of joints, and will be treated of under the heading of joint-disease. *See* Joints, Diseases of.

Traumatic dislocations, or those which are produced by violence, constitute by far the greater number, and are of chief importance to the surgeon. The violence which causes the dislocation may be *direct*, that is, applied to the bone in the immediate vicinity of the joint, as when a person falls on his shoulder and drives the head of his humerus out of the glenoid cavity; or *indirect*, when the force is transmitted from a distance—for example, a dislocation of the elbow caused by a fall on the palm of the hand. Apart from external violence, bones are occasionally dislocated as the result of sudden *muscular action*. This is more likely to occur if the joint has been previously the subject of dislocation from injury. Many cases are on record where the humerus has been dislocated at the shoulder by muscular action, the result of some sudden violent exertion, such as throwing a cricket-ball or wielding a club; and a case is mentioned by Holmes of a patient who dislocated his shoulder by suddenly turning when lying in bed. Another joint which is liable to be dislocated by muscular action is that of the lower jaw. The patella is liable to be dislocated outwards by the action of the rectus muscle, and this is especially the case in knock-kneed persons, because the anterior prominence of the external condyle, which in normal joints serves to counteract the oblique pull of the rectus, is no longer efficient for that purpose when the deformity renders the direction of the force still more oblique. Complete primary dislocation from muscular action, is, however, a rare accident, and very exceptional at any other joints than those mentioned. Dislocations occurring in partially paralysed limbs from irregular muscular action, and those resulting from disease, have sometimes been incorrectly spoken of as *spontaneous dislocations*.

The effect of muscular action is occasionally found to change the character of a dislocation. Thus a subglenoid dislocation of the humerus may be converted into a subcoracoid, and a sciatic dislocation of the femur into one on the dorsum ilii. Such dislocations are spoken of as *consecutive*, to distinguish them from those resulting immediately from the injury, which are called *primary*. The surgeon, by ill-directed efforts to reduce a displaced bone, may bring about a consecutive or secondary dislocation. The writer once saw all the regular dislocations of the hip produced, in succession, by attempts made to reduce a dislocation on the dorsum ilii, before the head of the bone was finally lodged in the acetabulum.

A dislocation is spoken of as *incomplete* or *partial* when, the capsule being only partially torn, or the ligaments being of abnormal length, the articular surface of one bone is not completely displaced from the articular surface of the other. Partial dislocations frequently depend on a general laxity of ligaments, such as is artificially produced in those trained to become clowns and tumblers. These persons acquire the power of distorting their joints in a manner closely resembling dislocations, but without tearing their ligaments, which are unduly elongated. These are, however, not true dislocations, but abnormal movements permitted by abnormal ligaments. Partial dislocations are very readily reduced. When occurring as the result of injury at the shoulder or hip, the ligaments are partially torn, and the head rests on the margin of the glenoid or cotyloid ligament, which may cause an indentation in the articular cartilage of the displaced bone. Arthrodial joints are more liable than others to be partially dislocated. When the displacement is lateral at the knee or ankle, the dislocation is generally incomplete, and when at the elbow not infrequently so.

As with fractures, dislocations may be *compound* or *simple*, the word ‘ compound ’ being used to indicate that the skin is torn over the joint, and its interior exposed to the atmosphere. Those joints which are covered in by muscles, as the hip and shoulder, are far less liable to compound dislocation than joints such as the ankle, wrist, and elbow, which have little more than skin to cover them. A compound dislocation is a very serious but not necessarily fatal accident. The danger lies in the fever, suppuration, and septicæmia which may follow acute traumatic arthritis; but if care be taken to thoroughly cleanse and purify the wound, and afterwards to keep it septic, little or no fever may follow, and the joint may recover even without limitation of movement. The writer has seen all the heads of the metacarpal bones of the fingers dislocated through a transverse wound in the palm, the result of a fall on the fingers, yet the patient recovered without any loss of power or motion in the hand. Compound dislocations are frequently associated with severe laceration of the skin and soft parts, and in these cases, as well as in those where the bones are splintered or the vessels damaged, it may be necessary to amputate the limb without delay. It is often a difficult question to decide, and one of great gravity, whether in the case of some compound dislocation an attempt to save the limb is advisable. Fibrous or bony ankylosis may be expected to result, should suppuration follow the injury.

Predisposing causes.—Dislocations from violence are rare at the two extremes of life. In children, injuries near joints are apt to produce separations of epiphyses; in old persons, fractures. Adult males, from exposure in their occupations, are more liable than females to dislocations. Paralysed limbs are more prone to dislocation than sound, and persons of weak muscular system than those who are strong. As illustrating the power of the muscles in supporting the joints, Astley Cooper cites the execution of Damien, who was sentenced to dismemberment. Four horses pulling for fifty minutes failed to tear away his limbs, which only yielded when the soft structures were divided. Some joints are more liable to dislocation than others, and the shoulder-joint, from its exposed situation and shallow socket, is more often dislocated than any other.

General signs, symptoms, and diagnosis of dislocation.—As the joints of the extremities are those which furnish nearly all the instances of dislocation, and as a symmetrical displacement is of extremely rare occurrence, a comparison of the sound limb with the one injured will generally afford immediate evidence of deformity when a dislocation has taken place. An experienced eye will detect the loss of contour in a moment, and a surgeon may often feel certain in his diagnosis before touching the patient. The angular appearance of the shoulder resulting from a dislocation is so characteristic, that a diagnosis by sight will often prove correct. Again, the position of the limb may be very suggestive of dislocation, as in dorsal dislocations of the hip, when the limb is shortened and adducted, so as to lie in front of the other; and as in the commoner dislocations of the shoulder, when the elbow projects from the side. There are, then, two signs of dislocation which may be detected by the eye, viz. (1) a deformed appearance of the joint, and (2) a peculiar position of the limb. The patient himself experiences severe pain in the injured joint, and a loss of voluntary movement.

These two symptoms are both present, though to a less extent, in cases of sprain. But in the case of dislocation there is a mechanical impediment to the natural movements, which will become more evident when an attempt is made to produce passive motion. A limitation of the normal movements is an important sign of dislocation. On the other hand, movements before impossible may, from the laceration of ligaments, become capable of being produced; thus a ginglymoid joint may, after dislocation, admit of lateral movement. But fixation is a far more constant and important sign than the occurrence of any new movement. When a careful examination is made, an abnormal projection, caused either by the bone displaced or that from which it has been dislodged, will almost certainly be felt, even if there be no deformity evident to the eye. Manipulation will further determine the absence of crepitus, and thus distinguish the injury from a fracture near the joint. A certain amount of synovial crepitus, from effusion of lymph and serum into the tendon-sheaths about the joints, is common after a dislocation, but this is easily distinguished from bone-grating. Another sign arrived at by comparison of one limb with its fellow is an alteration in the length of the injured extremity. Most frequently the dislocated member is rendered shorter, but in some cases, as in subglenoid dislocation of the shoulder, and thyroid dislocation of the hip, there is lengthening.

Besides the knowledge obtained by measuring the length of the two limbs, much information may be obtained by comparing the difference in the distances between two bony points in the sound and in the injured limb. Thus, the distance between the internal condyle of the humerus and the tip of the olecranon is unaltered in a case of supra-condyloid fracture of the humerus, whilst in dislocation backwards of the bones of the forearm this measurement is increased. There is greater tension in the muscles about a joint when a dislocation has taken place, than when there is a fracture; and a dislocation is reduced with a sudden jerk, and when reduced does not readily recur; whereas the deformity of a fracture disappears gradually under extension, and often has a tendency to be reproduced by muscular action immediately the extension is relaxed.

General treatment of dislocation.—It is important that the displaced bone should be reduced to its normal position in the joint with as little delay as possible, in order to limit the inflammatory effusion excited by its presence among the soft tissues, and in order that repair may at once proceed. Before discussing the methods of treatment, it may be well to consider the principal *obstacles to reduction.* First among these is muscular contraction —a fact readily proved by noting the ease with which a dislocation is reduced in a paralysed limb, and in a person under the influence of chloroform, or in a case of syncope. The capsule or ligaments of a joint may, in some instances, cause difficulty in reduction; thus, in the case of an enarthrodial joint, the head of the bone may not lie near the aperture through which it escaped, and in the case of a ginglymoid joint the strong lateral ligaments may escape laceration, and prevent the return of the end of the bone to its position between them. The intervention of a tendon between the joint-surfaces is a rarer, but even more serious, obstacle to reduction. It sometimes happens in the case of subastragaloid dislocation of the foot.

The complication of a fracture with dislocation may render reduction extremely difficult, or even impossible; as, for instance, where fracture of the neck of the femur complicates dislocation of the hip-joint. Happily such cases are extremely rare. The natural prominences around a joint may be found in certain instances to interfere with reduction; thus the coronoid process of the ulna forms an obstacle to reduction in dislocation backwards at the elbow, and the eminentia articularis of the temporal bone in dislocation of the lower jaw. The indications for treatment are to relax the opposing muscles or to overcome their opposition by extension; to manipulate the limb in such a manner as to return the displaced bone through the aperture in the capsule made by its exit; and to divide subcutaneously any ligament or tendon whose interference with reduction does not yield to properly applied extension or manipulation.

To overcome the resistance of the muscles, surgeons, before the days of anæsthetics, resorted to many expedients which would be regarded at the present time as barbarous. Nauseating doses of antimony or tobacco, hot baths, and bleeding till syncope was induced, were the favourite remedies to produce a constitutional effect; and then powerful pulleys were used to bring the bone into its place. By placing the patient under an anæsthetic, both voluntary and reflex muscular action are overcome, so that the surgeon is free to manipulate or extend the limb without exciting resistance or causing pain. It is only in the case of dislocations of long standing that he is ever likely to resort to mechanical aid; and then, if the patient be insensible, he must proceed with the greatest caution.

When a dislocation has been reduced, bandages or splints should be used to retain it in position till a certain amount of repair has been effected. At the same time, cold should be applied, first to check extravasation of blood and afterwards to allay inflammation. If the patient be confined to bed this is best done with an ice-bag or Leiter's coil placed over the joint; if he be allowed to walk about, evaporating lotions, containing ether or spirit, may be applied on lint. The joint should not be kept fixed longer than a fortnight or three weeks, lest difficulties in regaining movement should result from the formation of adhesions. Passive movements should be first commenced, and afterwards the voluntary be gradually encouraged. Friction, stimulating liniments, cold affusion, and galvanism may be employed, with benefit, to stimulate the muscles and absorbents of the part and assist in the recovery of movement.

Compound and Complicated Dislocations, Treatment of.—A compound dislocation—by which is understood one in which the articular end of a bone protrudes through the skin, or one where there is an open wound leading down to the displaced articular surface—offers grave considerations to the surgeon. Early in this century it was the rule to amputate in all such cases. Before the introduction of antiseptics, however, surgeons had discovered that by rigid cleanliness, rest, and free drainage, many of the limbs thus damaged might be saved. Still, the danger to life from prolonged suppuration, erysipelas, or septicæmia, was great. The stricter details of antiseptic surgery have done much to extend conservative surgery in this field. Each case is now treated on its own merits, and the question of amputation is decided by the accompanying complications. Severe laceration of soft parts and rupture of vessels would determine an amputation; comminuted fracture of bone generally either excision or amputation. Rupture of nerve would not of itself suggest amputation, for the nerve might be cleaned, refreshed, and reunited by means of catgut sutures. At the elbow, for instance, the ulnar nerve may be torn across, and yet the forearm may be saved and the function of the nerve be restored after suture. An instance of this kind has lately come under the notice of the writer.

In an uncomplicated case of compound fracture the surgeon should cleanse thoroughly the exposed articular surface with a solution of one part of carbolic acid in twenty parts of warm water, and should syringe out the joint-cavity and interstices of tissue with the same solution. The dislocation being then reduced, wire sutures may be used to bring together the skin; but it is most important that a free and dependent opening should be left for drainage. Carbolised gauze dressings should then be applied, and the limb be fixed upon a splint.

If these dressings are not at hand, irrigation of the joint, either with water or some weak antiseptic lotion, is probably the best way of purifying the wound and allaying extensive suppuration. When there is difficulty in reducing the dislocated bone through the skin and soft parts, it is often advisable to saw off its extremity. This has been done at the hip, shoulder, ankle, and wrist, as well as in dislocation of the head of the astragalus. Compound dislocation at the elbow may frequently suggest excision in order to save a movable joint; but such excisions run a far less favourable course than those undertaken for disease. A few years since the writer was called to see a compound dislocation of the elbow with separation of the humerus just above the condyles. The loose piece of bone was removed, and the ends of the radius and ulnar were sawn off. The patient recovered without any serious symptoms, and the hand was thus preserved, but a flail-like movement followed at the elbow.

In compound dislocations of the lower extremity it is scarcely advisable to make any attempt to preserve a movable joint. The wound having been cleaned and all loose fragments of bone removed, the limb should be fixed on an iron splint and retained rigidly in position by means of waxed, paraffin, or plaster of Paris bandages, till all inflammation and suppuration have subsided. A similar rigid fixation of parts should be secured in any case that the surgeon may have thought favourable for primary excision. Any abscesses which may result from the injury should be freely opened, and whilst the patient's strength is being drained by suppuration he should be supported by stimulants, quinine, iron, and such nourishing diet as he may be capable of taking. If it is evident that he is gradually losing flesh and strength, the surgeon must interfere at the proper time, and insist on the necessity of amputation to prevent further strain on the constitution and consequent death from exhaustion. After such amputations, provided there is no general septicæmia, patients often recover rapidly.

Extension and counter-extension in the treatment of dislocations.—Rotation, as a method of reducing dislocations, being only of service in the case of enarthrodial joints, extension of the limb will continue the method most generally applicable for the restoration of displaced bones to their proper positions, though, with the aid of chloroform, the power exerted need be comparatively little, save in the case of dislocations of long standing. *Extension* may be applied directly by the surgeon grasping the limb in his hands and pulling upon it, or indirectly through a round towel secured by means of a clove-hitch to the limb. The advantages of the towel are that it gives a firmer hold, and that it enables more than one to aid in making extension. It should be applied above the elbow for dislocation of the shoulder, and above the knee for dislocation of the hip, so that traction may not be exerted on any other joint than the one dislocated. To protect the skin from injurious pressure it is well to first apply a few turns of a damp flannel or linen bandage. Additional force may be obtained by the employment of pulleys, or such mechanical contrivances as Bloxam's dislocation tourniquet and Jarvis's adjuster; but since the introduction of chloroform these appliances have been altogether discarded for recent dislocations, and are but rarely employed for those of long standing.

Counter-extension is the force used in the direction of the patient's body, to prevent him from being dragged away by the power used in extension. It is seldom that the weight of the patient is alone sufficient for counter-extension when reducing a dislocation, though in the case of fracture the patient's inertia is thus frequently made use of. Counter-extension is sometimes made by the surgeon himself, as when he places his heel in the axilla or foot upon the perinæum for the reduction respectively of the shoulder and hip. At other times, when greater force is required, the counter-extension is entrusted to assistants; but when pulleys are used it is necessary to fix the pelvis or shoulder girdle by means of a padded leather strap, a round towel or sheet, attached above to some fixed point. However applied, it should be understood that counter-extension ought to be of a passive kind, continuously acting in one direction, whilst extension, which is more immediately under the control of the surgeon, may be modified both in force and direction according to the requirements of the case.

Unreduced Dislocations. — When a dislocation has been overlooked or left unreduced, the deformity occasioned by the displacement becomes gradually more evident than at the time of the accident, first from the absorption of extravasated blood, and afterwards by the wasting of the disused muscles around the joint. Loss of motion, however, seldom remains absolute, the movements gradually improving after a time, and sometimes becoming extensive. This is especially the case in dislocations of enarthrodial joints, such as the hip and shoulder. Here the displaced bone will hollow and form for itself a new cavity on the surface where it rests; new ligaments are formed from the connective tissue cells of the surrounding structures, and a fairly well-formed joint results. The process by which this new adaptation is effected is not a mere passive absorption occasioned by the pressure of the displaced head of bone, but an active sub-inflammatory change, whereby new bone is produced where required to resist pressure, and new ligaments of great density are developed to complete the joint. Meanwhile the cup, from which the dislocated bone has escaped, undergoes atrophy, decreasing in depth and diameter, and becoming filled partly with bony undergrowth and partly with fibrous tissue. A good specimen of unreduced dislocation of the head of the femur upon the pubes, illustrating these changes, is to be found in the museum of Guy's Hospital. The dislocated head resting against the anterior inferior spine of the ilium had there excited such activity in the periosteum and its fibrous connexions, as to form for itself a shallow cup, whilst the acetabulum is seen to be contracted and shallow.

The chronic inflammatory changes brought about by the displaced bone give frequently to the new joint an appearance similar to what is met with in osteoarthritis, plates of bone being formed in the fibrous structures around, whilst the cartilaginous surface becomes worn off, and replaced by a porcelain-like lamella. This loss of cartilage does not, however, always take place, as is proved by a case dissected by Cadge sixteen years after upward dislocation of the hip. The new joint was remarkably complete, and lined by a dense, pearly-white tissue resembling fibro-cartilage, whilst the head of the femur was still covered by its cartilage. Thus it will be seen that in some cases a new articular surface—framed on the model of the original joint—new ligaments, and new synovial membrane may be developed to take the place of a joint destroyed by dislocation. But the displaced bone does not always accommodate itself in this way to its altered relations, and ginglymoid joints, when dislocated, often become permanently fixed by fibrous or even bony ankylosis. Much will depend upon how soon after the injury movements are commenced, and with what perseverance they are continued.

Treatment.—The reparative and pathological changes which have been described as occurring in the neighbourhood of a joint long dislocated, should be borne in mind by a surgeon contemplating the reduction of any such dislocation, and he should ask himself whether the benefit likely to accrue sufficiently justifies the risks to which the patient may be subjected in attempts made to replace the bone. The opposition of fibrous bands of great density, of rigid and contracted muscles, of displaced tendons and intervening capsule, will have to be encountered, as well as the obstruction resulting, in cases of long standing, from altered bone-surfaces. No fixed rule can be laid down as to the time when it ceases to be justifiable to attempt reduction, as reparative activity will vary with the individual, and will not progress evenly with time. Astley Cooper's oft-quoted rule is given in his own words, to show that even he, writing before the days of anæsthetics, was not so rigid in his views as has been represented. 'I am of opinion,' he says, 'that three months after the accident for the shoulder, and eight weeks for the hip, may be fixed as the period at which it would be imprudent to make the attempt at reduction except in persons of relaxed fibre, or of advanced age. At the same time I am fully aware that dislocations have been reduced at a more distant period than that which I have mentioned; but in many instances the reduction has been attended with the evil results which I have just been deprecating.'

Among the evil results of prolonged and forcible extension, carried out with the object of reducing a dislocation, the following may be mentioned as having occurred in attempts to reduce old dislocations of the shoulder:—Severe subcutaneous lacerations resulting in extensive blood-extravasations; rupture of the axillary vein or artery, with subsequent traumatic aneurism; tearing through of the pectoralis major or cords of the brachial plexus; fracture of the humerus, glenoid cavity, or axillary ribs; rupture of the skin, and in one case recorded by Guérin, the limb itself was torn off at the elbow-joint. In attempts made to reduce old dislocations at the hip, the large vessels are less exposed to injury, though they have not always escaped; but fracture of the femur is an accident which has happened on several occasions, and diffuse suppuration has frequently followed forcible manipulation, and has sometimes ended in death. At the elbow-joint, rupture of the brachial artery and damage to the median nerve have resulted from force used to reduce an old dislocation. In spite of the warning of these accidents, cautious attempts at reduction may be made after lengthened periods, especially in persons of slight muscular development, and those in whom, the dislocation having been overlooked, splints may have been applied, and no previous attempts have been made to replace the bone. Should, however, sufficiently free movement have been obtained in the dislocated position to render the limb of service, it may be doubted whether any attempt at reduction is then advisable.

For the reduction of long-standing dislocation, an anæsthetic should invariably be administered till complete muscular relaxation is obtained. The surgeon should then take the limb, flex, extend, abduct, adduct, and rotate it till all the fibrous adhesions are broken down. In addition to this he may find it necessary to divide, with a tenotomy-knife, bands which cannot be broken, or displaced tendons which obstruct the return of the bone. Having overcome all resistance to the free movement of the bone, he next proceeds to manipulate it in a manner best calculated to restore it to its proper position. He must not expect to hear it return with a jerk and snap as in recent cases, but must be content to see the limb restored to its normal length and position as sufficient indication that the bone has returned to its cavity. Having obtained this result he should secure the limb in this position by means of splints, and apply over the joint an ice-bag or Leiter's coil to subdue any inflammation that may have been excited. The head of the bone, when lodged over the spot it should normally occupy, will gradually cause absorption of any capsule, fibrous or muscular tissue intervening between it and the socket. In the *Guy's Hospital Reports* for 1884, there are, related by Cock, several cases of dislocation of the shoulder which could not be reduced, owing, as it was supposed, to the intervention of capsule; but good results were eventually obtained by retaining the humerus in position by means of an air-pad in the axilla, till absorption had taken place and new ligaments had been formed.

For description and treatment of individual dislocations, *see* under Ankle; Elbow; Hip; Shoulder, &c.

R. Clement Lucas.

DISSECTING ANEURISM. *See* Aneurism.

DISSECTING WOUNDS. *See* Poisoned Wounds.

DISTAL LIGATURE. *See* Aneurism.

DORSALIS PEDIS ARTERY, The, is a continuation of the anterior tibial, from the middle of the ankle in front, to the interval between the bases of the first and second metatarsal bones. The guiding line is taken between the points mentioned.

The coverings are: skin; superficial fascia, with a plexus of veins and the musculo-cutaneous nerve; deep fascia; just before it ends it is crossed by the innermost tendon of the extensor brevis digitorum. Inferiorly it rests on the astragalus, the scaphoid, the internal and middle cuneiform bones. Externally are the innermost tendons of the long and short extensors. Internally, and serving as a guide, is the tendon of the extensor proprius pollicis. The nerve is on the outer side; venæ comites accompany the artery.

Branches.—(*a*) The tarsal, running outwards on the bones, to anastomose with the anterior peroneal, external plantar, and the metatarsal artery. (*b*) The metatarsal runs across the bases of the metatarsal bones; it has similar anastomoses to the tarsal. (*c*) Dorsalis hallucis. (*d*) Communicating with the external plantar, passing downwards between the first and second metatarsals. In the sole the communicating gives off (*e*) the anterior magna pollicis.

Ligation.—Make an incision in the guiding line two inches long; cut through skin and fasciæ, and feel for the pulsations of the artery; recognise the innermost slip of the extensor brevis digitorum on the outside and the pollicis on the inner side; and, pulling the former outwards and the latter inwards, open the sheath and pass the needle from without inwards, to avoid the nerve. Sometimes the artery is absent.

James Cantlie.

DRACUNCULUS. *See* Filaria or Dracunculus Medinensis.

DRAINAGE is the system by which the surgeon carries off liquid accumulations from the body, as the agriculturist does from the land. Both know that, while some moisture is essential to nutrition and growth, its excess leads to decomposition and waste. Drainage was the intention of the old surgical practice of counter-openings, tents, and setons; and John Hennen went so far as to draw a woollen thread through an accumulation of pus '*to perform the part of a syphon.*' But it was not until 1855 that Chassaignac established drainage, as a general principle and practice of surgical therapeutics. He was not only influenced by the idea, but followed the method, of agricultural drainage, substituting for tile drain-pipes perforated indiarubber tubes, which, after trial of metal and bone tubes, are still admitted to be the drain-pipes most generally applicable to surgical practice. The essential facts in Chassaignac's system of drainage are—that indiarubber tubes may be made to traverse and dwell in the muscular and bony structures of the limbs, the large joints, or the great visceral cavities, without producing irritation; and that, as they fill with discharge by capillary attraction, they do not give admission to air from without. Acting on these lines, the distinguished French surgeon and his earlier followers, employed drainage in evacuating purulent collections; but the method has been gradually, and most beneficially, extended to the prevention of suppuration, by carrying off serous effusions. These, if retained, are liable to decomposition, and, by mechanical tension and nerve-irritation, are potent causes of inflammation, which is opposed to healthy nutrition and repair, and is the prime factor in the chain of pathological events leading to blood-poisoning and death.

But though tubes be the most generally applicable instruments for drainage, it is important to bear in mind that they are not essential to it. The parallel between agricultural and surgical drainage holds good in the utilisation of natural, physical, and physiological resources for preventing the stagnation of liquids, and carrying them off when they do accumulate. In the flesh, as in the field, position both dams and drains.

To facilitate drainage by gravitation should always be the aim of the operating surgeon in planning the direction and extent of wounds, in the manner and time of closing them, and in placing the patient after operation. Thus, in amputation of the breast, a free incision, parallel with the transverse axis of the body, is most conducive to healing by the first intention, or favouring natural drainage outwards and downwards; all the more so if the patient's bed be so made as to incline the body slightly towards the side operated on. One great advantage in Teale's method of amputating results from the facilities for natural drainage, offered by the position and shape of the rectangular flaps. When extravasation of urine attends stricture, a free dependent incision in the middle line of the perineum arrests mischief, locally and constitutionally, in direct proportion as it favours easy drainage. On the same principle is based the golden rule, that when it is determined to open an abscess the most dependent position should be chosen.

As position assists natural drainage, so does pressure; and, by a little ingenuity, pads may be adjusted to act as banks in directing outwards extravasated fluids, and preventing their permeation into healthy tissues. But however dexterously and economically natural resources be utilised, drainage is often impracticable without the employment of tubes. In introducing these, probes and trocars are useful adjuncts, but they may generally be dispensed with by just inserting the end of the drainage-tube into the wound, and passing it with a gentle corkscrew impulse. In the case of fresh wounds, the drainage-tube is laid where most convenient before the edges are brought together.

Drainage-tubes, like most other good things, are liable to abuse. They may often be dispensed with by lightly compressing wounds and their surroundings to check effusion. Dryness favours healing. A slight dependent opening is a useful safety valve, not always indispensable, but, in case of doubt, never to be neglected. When drainage-tubes *must* be used, they should be neither too fine nor too short for efficiency, nor so numerous, thick, and long as to act like foreign bodies, and prevent the contact of surfaces of which the coalescence is desired. For the same reason, drainage-tubes should be shortened as soon as practicable, and removed when they cease to be absolutely necessary. In case of doubt, a wire or thread may be left in the track of a removed drainage-tube, and used in drawing through another, if required. Meanwhile, the wound can be allowed to consolidate under pressure and absorbent dressings, which are always the complement, often the substitute, of drainage-tubes. To prevent the tube completely slipping into the wound—a not infrequent and rather troublesome occurrence—its outer end should be left of good length, or be secured by one or two loops threaded through its side, and fixed by adhesive plaster or bandage. Catgut and horsehair are often used as minor drains, but absorbent dressings and gentle pressure will dispense with their necessity in the great majority of cases.

To secure the combined effect of position, pressure, and drainage-tubes, in carrying off discharges, it is important to secure the freedom of the outer end of the tube. This may be done by passing it through a hole in the dressings next the body, or between the edges of two pads or folds of absorbent tissue, the bandage exercising pressure around the tube so as to direct fluid through it, and not over its orifice so as to close it. An absorbent pad, lightly secured over the outer end of the drain-pipe, acts as the receptacle of the drained products, and may be changed as often as deemed necessary, without prejudice to the great principles of rest and cleanliness. Thus utilised, drainage is, in itself, a great therapeutical resource, and in combination with other principles of treatment, more especially rest, position, and pressure, is a powerful factor in the physiological treatment of surgical states.

Sampson Gamgee.

DRAINAGE-TUBES.—Of the materials used for draining wounds, the most widely employed is india-rubber tubing, but decalcified bone, glass, metal, and spiral wire tubes either are or have been used, and, under special circumstances, strands of horsehair, silkworm gut and catgut act efficiently. The size of the tubes will depend on that of the cavity to be drained; but for large surfaces, such as those of amputation flaps, two or three smaller tubes are preferable to a single large one placed across the wound, as they interfere less with the coaptation of the flaps, and favour the more uniform exit of the discharges. The depth of the wound should be ascertained with a probe or the sinus-forceps, and the tube cut to the required length, and also in such a way that the external aperture lies flush with the surface; for if left too long the pressure of the dressings may double the tube on itself, and obliterate its channel, or press the inner extremity of it against the tissues and irritate them. Care must be taken that the external end of the tube does not slip within the wound, and with this object a loop of silk or horsehair should be tied to each side of that end, so that the pressure of the dressing against these little anchors of silk or horsehair may maintain the tube in its place.

When tubes are placed in cavities such as the thorax, special care must be taken that they do not slip inside; the safest plan is to fix the outer end of the tube to an india-rubber shield, thus:—Take a piece of sheet india-rubber and cut a hole in the middle of it of the size of the tube, then place the outer end of the latter through the hole, and cut the projecting piece longitudinally into four strips, and stitch each one down to the india-rubber shield. Drainage tubes do not, as a rule, need removing till the third or fourth day, by which time a track will be formed, which will facilitate their replacement. They will need shortening from time to time, according to the progress of the case. *See* Empyema.

India-rubber tubes.—The red rubber tubes are the best, and the strength of the walls should be sufficient to maintain their patency against the pressure of the tissues; the size of them should vary from that of a quill up to that of the little finger. They should be perforated here and there with holes, extending over about one-third of their circumference; but when the tube has to pass some distance through the tissues before reaching the cavity to be drained, the outer part of it should not be perforated, as the granulations are liable to grow in and obstruct its calibre. The prepared tubes should be kept ready for use in a five per cent. solution of carbolic acid.

Decalcified bone tubes were introduced by Neuber, of Kiel; he used tubes drilled from ox-bones; Macewen, of Glasgow, advocated decalcified chicken-bones, on account of their cheapness. The tibiæ and femora, after being scraped clean, are placed in hydrochloric acid and water (20 per cent.) until softened; the marrow and endosteum are then removed, and the bones returned for a time to the acid; they are finally trimmed and perforated, and kept ready for use in carbolic acid and glycerine (1 in 10). The longest tubes are a little over three inches, and the widest over half an inch. In 100 observations, the time that these tubes resisted absorption was over eight days; if they be required to resist the tissues still longer, they should be kept in a chromicised instead of a carbolised solution. The advantages claimed for decalcified bone-tubes are that they are non-irritating, act as perfect drains, and are absorbed by the surrounding granulation-tissue when no longer required. On the other hand, it has happened that in some cases the wound has healed with the tubes enclosed and unabsorbed; whilst at other times they have been too quickly absorbed, and have collapsed before they have fulfilled their function.

Glass tubes have been introduced into ovariotomy practice by Keith; they are of various sizes, and have perforations at one end; through these apertures the fluid poured out into the peritoneal cavity, enters and rises in the tube, from which it is drawn off by a suction syringe.

Spiral wire tubes have been recommended by Robert Ellis as well adapted for draining circuitous tracts during long periods, on account of their bore not being diminished by bending, nor flattened by the contracting orifice of a sinus; they are made of fine brass or copper wire coiled into a spiral.

Strands of horsehair, catgut, or silkworm gut make efficient drains, so long as the discharge is serous, but when it becomes purulent they cannot be relied upon; they all act in a similar manner, viz. by capillary attraction or syphon action, the fluids passing along the fine capillary channels between the hairs, &c. The horsehair should be purified in alkali, and then kept in a solution of carbolic acid (1 in 20). The size of the drain should be gradually diminished as required, by the removal of a few strands from time to time. It is claimed for catgut that it serves its purpose and is then absorbed, and so avoids both the necessity for dressing a wound in order to shorten the tube, and the difficulty of knowing at what rate to do this; and that with it, as with the decalcified bone drains, the theoretical perfection of one dressing only from first to last is possible. It should, however, be admitted that owing to the swelling of the catgut, and its incorporation with the tissues, its efficiency as a drain may be interfered with too soon, whilst in other cases it remains unabsorbed after it has ceased to be required. Bilton Pollard.

DRESSING OF WOUNDS. *See* Wounds.

DUCHENNE'S PARALYSIS. *See* Pseudo-hypertrophic Muscular Paralysis.

DUGAS'S TEST is for dislocations of the shoulder, and depends upon the fact that, owing to the roundness of the chest-wall, it is impossible for both ends of the humerus to be in contact with it at the same moment. Hence a patient with a dislocation cannot place the hand on the opposite shoulder with the elbow touching the ribs. *See* Shoulder, Dislocations of the.

DUPUYTREN'S CONTRACTION is that deformity of the fingers which is due to a gradually increasing thickening and contraction of the palmar fascia and its prolongations into the digits. It is almost unknown in females, but is common in males after twenty-five years of age. Not a few instances can be traced primarily to injury, such as a punctured wound; some may be traced to the habitual use of instruments which cause pressure upon the palm, but in the majority no such cause can be ascribed, and the condition occurs in persons of gouty tendency or inheritance, although they may be exempt from other manifestations of the diathesis. It is very frequently hereditary. The contraction may be confined to the fascia of the palm, or it may be increased and even mainly arise from a contracted state of the palmaris longus. But the fact of most importance is that the tendons of the flexors of the fingers are unaffected and lie free in their sheaths and in their natural relations, and therefore removed from the bands, which are superficial and tangible. The joints also are unaffected. The ring and little fingers are most frequently implicated, but the middle, the index, and the thumb may be involved. Superficially the skin of the palm is puckered, and is bound to the subjacent ridge at the line of the transverse furrow, as well as at other spots, but is not closely attached throughout. The proximal phalanx is drawn down and cannot be straightened, and the two distal phalanges are similarly acted upon in proportion to the extent of the condition, which in extreme cases may be such that the tip of the finger is drawn down into the palm. Dissection proves that this is effected by the thickening and contraction of sections of the palmar fascia, which pass into the affected fingers, and of its prolongations, particularly those which are inserted into the periosteum of the first phalanx, externally to and along the borders of the sheath of the flexor tendons.

Treatment.—By far the most successful method of dealing with this condition is that of multiple subcutaneous incision, recommended by Mr. W. Adams. A fine short fascia-knife is introduced between the skin and the band, and the latter is divided from above downwards in several spots. The first incision should be above the transverse fold, the next between it and the web of the fingers, and others should divide the lateral band in the fingers. In the latter great care is needed that the point of the knife is not depressed, so as to injure the vessels and nerves. Each puncture should be covered by a pledget of lint, and the extended fingers bandaged to a padded metal splint on the palmar aspect of the hand. Subsequently, it is necessary that a metal apparatus embracing the wrist and extending along the dorsal surface of the finger, to the tip of which it is attached by a cap, should be worn for some time at night, and passive motion be used daily. Or, if immediate extension cannot be effected, it must be gradually brought about by means of a rack-and-pinion apparatus. Where this treatment has failed, or in cases where it is not applicable, a triangular flap of skin may be dissected up from the palm, and the contracted bands freely divided or even dissected out, the skin being readjusted and a splint applied. JOHN H. MORGAN.

DUPUYTREN'S SPLINT is a straight splint about four inches wide, reaching from the internal tuberosity of the tibia to four inches beyond the sole of the foot; it is notched at the lower end, so as to give the ankle-bandage a firmer grip of the splint. The pad, which should be thicker at the lower part, ought to reach only to the internal malleolus. It is used in the treatment of Pott's fracture, with much eversion of the foot. BILTON POLLARD.

DURA MATER, Wounds of the. *See* ENCEPHALITIS, MENINGITIS.

DYSPHAGIA—or swallowing with difficulty—is a sign either of paralysis or of spasm of the parts concerned, or of disease of the pharynx and œsophagus, or of disease in their neighbourhood.

1. *Paralytic dysphagia* may have a central origin in disease of the brain or cord, and occurs after diphtheria or some other fevers; or it may have its origin in nerve injury or disease, either inside or outside the skull. Or it may have a reflex origin, from thoracic or abdominal disease. In paralysis of the pharynx, the finger passed into it causes no contraction; there may be dilatation of the parts, with accumulation of food; if regurgitation takes place, it is not so immediate and violent as in spasmodic dysphagia.

2. *Spasmodic dysphagia*, usually of central origin, may be due to some special cause, as strychnia poisoning or tetanus or hydrophobia, or inflammation of the cervical cord. It may occur early in insanity, and in epilepsy. It may have a reflex origin, from intestinal or uterine irritation, and perhaps many spasmodic strictures are started by some local irritation. The ordinary spasmodic stricture is usually a disease of nervous girls and middle-aged women; it often exists with other signs of nervousness in the patient or her family; it is very rare in men. It is, in many cases, not continuous or progressive or consistent

in its symptoms; it is not marked by much pain, or craving for food, or emaciation, or cough. There is no swelling in the neck, no secondary growths, no hæmorrhage. Solids may go down better than fluids; the degree and position of the stricture may alter; it vanishes under an anæsthetic.

Among the slighter cases are those of 'stammering' in deglutition, those of globus hystericus, and those where swallowing is painful and difficult long after an obstacle has been removed. In more severe cases there is complete inability to swallow: 'the food is flung back by a spasmodic tube, not falteringly passed along a variable segment of a diseased one, or arrested as it nears the stricture to accumulate above its ring.' This immediate violent return of a mouthful of milk or food, and its forced ejection through mouth and nose, is a very important sign of spasmodic stricture.

Spasmodic stricture is often cured by electricity. In cases plainly due to nervousness, frictional electricity, drawing sparks from the neck, is likely to do good. In cases where the continuous current is used, the positive pole should be at the back of the neck, and the negative should be over the pharynx, or inside if the patient can bear it. Tonics or antispasmodics may be given; the mental and moral tone of the patient must be improved. The introduction of a bougie may be followed by a hysterical fit, and rapid recovery. But in grave cases, of many years' duration, the cure is tedious, and relapses are common.

3. Of diseases of the *pharynx and œsophagus* which cause dysphagia, the chief are as follows: of the pharynx, acute tonsillitis, and perhaps—at least in children—mere chronic enlargement of the tonsils without fresh inflammation; acute pharyngitis, pharyngeal erysipelas, retropharyngeal abscess and tumour, and spinal disease, naso-pharyngeal tumour, and ulceration just at the back of the pharynx, which may be hidden by the uvula. Of the œsophagus, there are inflammation, both erysipelatous and membranous, pouches, diverticula, valvular obstruction, and certain innocent tumours. But, above all these, there are ulceration, simple or syphilitic, and malignant disease. Hence come simple stricture and malignant stricture; but in many cases it is not possible to decide which of these two is present.

4. *Simple fibrous stricture* is due either to simple fibrous thickening of the parts, or to the scarring and contraction of ulceration, simple or syphilitic. Simple ulceration follows the swallowing of boiling water, or soap-lees, or strong acid—either at once, or not for some months after the accident. There is no tumour in the neck, no diseased lymph-glands; the emaciation is proportioned to the want of food; the stricture may bleed, but has no foul discharge; it may feel smooth to the bougie.

Its treatment is never free from risk of perforation, or of mediastinal inflammation even without perforation. The advice to pass bougies directly after the accident, without waiting to see whether stricture will occur or not, is wrong; they might just cause it. Only a little fluid food should be given, and nutrient enemata should be used for some days.

When the stricture has come, and instruments must be used, a black olivary catheter is useful. It may go more easily just after a mouthful of wine, and with the head a little thrown back. In a case under the writer's care, the patient, a girl of twelve, could pass the catheter herself, through a double stricture. A year may be spent before the stricture is dilated; and constant watching in after-life is absolutely necessary.

5. *Malignant stricture*, usually epithelial cancer of the upper or lower end of the œsophagus, is most common in men; it is very rare under forty. In most cases the dysphagia is gradual; but in some it comes without warning and with curious suddenness. The emaciation is usually more than is due to any mere want of food; the regurgitant food may be stained with blood; and, late in the disease, there may be a foul smell from the throat, frothy expectoration tinged with blood, and a perceptible fulness in the neck, with enlarged lymph-glands. Regurgitation, whether in fibrous or malignant stricture, takes about a minute; it may not occur at all. Pain even may be absent. With the bougie, and in some cases with the finger, a hard stricture is found, which may have a ragged feel.

In some cases, food may be given through a rubber catheter, or a fine tube may be worked down over a long catgut, and tied in; or Mr. Symonds' short tubes may be used, allowing the patient the pleasures of taste.

6. *Dysphagia* may be due to disease in the neighbourhood of the pharynx and œsophagus. Except some rare cases of dysphagia from advanced spinal curvature, or disease of the thyroid gland or hyoid bone, or mediastinal tumours, the diseases are usually laryngeal or arterial.

In laryngeal paralysis there may be dysphagia; for the larynx is raised, closed, and covered, in deglutition; and thus paralysis either of the external or of the internal laryngeal muscles may, by want of coordination, cause dysphagia. In inflammation of the trachea swallowing is painful, and therefore difficult. In œdema of the glottis, acute or chronic, there is dysphagia, and food passes into the larynx; and in perforation of the trachea from ulceration of the œsophagus, there is very distressing dysphagia, with violent coughing-up of food. Whenever dysphagia is connected with cough or dyspnœa, the larynx must be examined.

Aneurism of the carotid or innominate or aortic arch, may cause dysphagia, with pain at the sternal notch. It is unwise in these cases to pass any instrument down the œsophagus.

7. Lastly, a foreign body may remain lodged in front of the epiglottis, or in the pharynx, or buried in the loose tissue behind the pharynx, in such a way as to elude observation and yet cause severe dysphagia.

Stephen Paget.

DYSPNŒA, i.e. difficulty of breathing, is produced under all conditions which cause defective oxygenation and increased carbonisation of the blood, the anomalous composition of the latter acting in turn as a stimulus upon the respiratory centre, situated in the medulla oblongata.

Symptoms common to most forms of dyspnœa are: action of the accessory muscles of respiration; increased frequency, or possibly deepening and prolongation, of the respiratory movements; and—in higher degrees of difficulty of breathing—cyanosis, orthopnœa, dilatation of the pupils, and even general convulsions. In the most severe cases the action of the heart becomes irregular or arrested.

The very varied conditions under which dyspnœa may occur may be subdivided into: *Conditions preventing or impeding the entry of air into the air-passages.*

I. *In the nose and naso-pharyngeal cavity.* (1) Acute catarrhal or inflammatory tumefaction of the mucous membrane (especially acute coryza in infants). (2) Neoplasms (mucous polypi, adenoid vegetations, naso-pharyngeal polypi, malignant growths). (3) Deviations of the septum nasi. With rare exceptions the dyspnœa in all these cases is not severe but characteristic. The mouth is kept open; respiration is accompanied by a snuffling noise, if the obstruction be situated in the nasal cavities proper; by more snoring sounds, if it be in the naso-pharyngeal cavity; the voice has a peculiar nasal timbre; the dyspnœa in the sucking child comes on when it takes the breast and in sleep, in cases of adenoid vegetations in sleep.

II. *In the pharynx.* (1) Acute tonsillitis and hypertrophy of the tonsils; (2) benign and malignant new-formations; (3) foreign bodies; (4) traumatic and œdematous pharyngitis; (5) syphilitic contraction; (6) retropharyngeal abscess. In these forms dyspnœa is accompanied by a rough, snoring noise, which is distinctly different from laryngeal and tracheal stridor, less distinguishable from the noise of nasal and naso-pharyngeal obstruction. The dyspnœa may be severe. The voice is thick, deglutition greatly impaired.

III. *In the larynx.* (1) Acute laryngitis in infants; (2) œdematous laryngitis; (3) abscess; (4) erysipelas; (5) laryngeal diphtheria (croup); (6) benign growths when large; (7) malignant neoplasms; (8) syphilis; (9) tuberculosis; (10) perichondritis; (11) ankylosis of the crico-arytænoid articulations, if the cords be fixed near one another; (12) lupus; (13) lepra; (14) fractures and dislocations; (15) wounds; (16) foreign bodies; (17) membranous occlusion (webs); (18) bilateral paralysis of the recurrent nerves (dyspnœa occurs on exertion only); (19) bilateral paralysis of the glottis-openers; (20) unilateral paralysis of a glottis-opener in infants; (21) spasm of the glottis; (22) perverse action of the vocal cords; (23) compression of the larynx by tumours, &c. Laryngeal dyspnœa is characterised by loud, stridulous, sometimes sonorous respiration, the inspiratory phase being, in most cases of laryngeal difficulty of breathing, solely or prominently concerned. It may, however, be purely expiratory (as in cases of pedunculated subglottic growths, driven during expiration against the lower surfaces of the vocal cords), or mixed (as in cases of compression of the larynx). It may be constant (as in paralytic affections), or intermittent (as in spasms); accompanied by disorders of the voice (as in most cases of laryngeal dyspnœa), or not (as in perverse action of the vocal cords, and in bilateral paralysis of the glottis-openers).

IV. *In the trachea.* (1) Benign and malignant neoplasms; (2) syphilis; (3) intratracheal stenosis, from syphilitic or traumatic contraction, foreign bodies, pseudomembranous deposit, post-tracheotomic granulations; (4) compression of the tube by goitre, aneurisms, enlargement of cervical or bronchial glands; tumours of the œsophagus, emphysema of the cellular tissue of the neck, diseases of the vertebral column or of the bones of the thorax, &c. In tracheal dyspnœa, respiration is accompanied by stridor similar to, but hardly ever as sonorous as, that of laryngeal dyspnœa, and the cough has a peculiar brassy character. A valuable differential symptom between laryngeal and tracheal dyspnœa is, that in the former the larynx makes considerable respiratory movements, whilst in the latter it stands quite still, however great the difficulty of breathing may be.

In all the cases under II.—IV., in which the narrowing is considerable, the respiratory movements are prolonged, and there is often inspiratory depression of the epigastrium and of the intercostal spaces. This drawing in is a valuable sign of the dyspnœa being serious. In such cases there is a tendency to œdema of the lung setting in. The degree of the dyspnœa does not only depend upon the degree of the stenosis, but also upon the quickness of the development of the latter. In equal narrowing of the lumen of the air-passages, dyspnœa is the greater the quicker it has become developed. For the differential diagnosis of the individual affections so far mentioned, the reader is referred to the corresponding articles.

V. *In the bronchi.* (1) Capillary bronchitis; (2) diphtheritic deposits; (3) foreign bodies; (4) intrabronchial tumours; (5) intrabronchial narrowing by thickening or cicatrisation in cases of syphilis, &c.; (6) compression of bronchi by aneurisms, mediastinal and pulmonary tumours and abscesses, enlarged bronchial glands, pericardial exudation, &c. In the cases mentioned under 3–6, there is on the affected side thrill and diminution of the thoracic expansion, full and high percussion-note, and absence or diminution of the respiratory sounds, which may be replaced—if the obstruction be only partial—by sibilant or rattling, often far-audible noises. The action of the other lung is often increased. The voice in these cases is clear, but may be weak.

VI. *In the lungs.* (1) Pneumonia and other inflammatory processes; (2) œdema; (3) collapse and atelectasis of the lungs; (4) diseases destroying the respiratory tissue (phthisis, gangrene, &c.); (5) compression of the lungs by pleuritic effusions or tumours; (6) hydrothorax; (7) pneumothorax.

FELIX SEMON.

DYSURIA.—Difficulty in Micturition. *See* STRICTURE OF THE URETHRA.

E

EAR, EXTERNAL, Diseases of the. For convenience of description the ear is divided into three parts: external, middle, and internal.

EXTERNAL EAR.—*Methods of Examining the Ear.*—The best method of illuminating the interior of the ear is by means of reflected light from a concave mirror. Diffused daylight is the best, but failing this, lamp or gas light will serve the purpose. The mirror should be provided both with a handle and with some contrivance for attaching it to a head band, and should have a focal distance of about six inches. The patient should be seated between the light and the surgeon, with the affected ear turned towards the latter. The light should be thrown on the ear, and any abnormal condition of the pinna and the external orifice of the meatus noticed. The auricle should next be grasped with the fore and middle fingers of the left hand, pulled backwards and upwards, a speculum of the requisite size inserted with a gentle rotatory movement, and kept in position by the forefinger and thumb. Any flakes of epithelium or small masses of cerumen obstructing the view should be removed with a pair of angular forceps or by the syringe. If no exceptional obstacles are encountered, the entire osseous canal can be seen with the tympanic membrane stretching across its deeper extremity. This, in health, is of a delicate bluish-grey colour, and highly polished. The most prominent object to be seen on the membrane, near its upper border, is the short process of the malleus; projecting downwards and backwards from this, to a point somewhat below the middle of the membrane, is a white or yellowish-white streak—the handle of the malleus. Extending from the lower extremity of this, downwards and forwards, is a bright triangular reflection of light, called the cone of light, its apex directed to the manubrium. From the short process of the malleus can be noticed a ridge passing backwards to the periphery, called the posterior fold, and a smaller and less sharply defined one—the anterior—is seen in front of the process. The part of the membrane above these two folds is known as the *membrana flaccida*. If the membrane be very thin, the long process of the incus can be observed as a whitish streak, parallel with and behind the upper part of the manubrium. Having inspected the membrane, the next step is to ascertain its mobility, and the perviousness of the Eustachian tube. This may be effected by Valsalva's or Politzer's methods, or by catheterisation.

(*a*) *Valsalva's method* of inflating the tympanum consists in forcible expiration, with the nose and mouth closed.

(*b*) *Politzer's method* is as follows:—The patient is directed to take a mouthful of water and retain it till told to swallow; the nosepiece of the air-bag is then inserted into one nostril, and the escape of air through the nose prevented by closure of both nostrils with the index finger and thumb. As the patient swallows the bag is forcibly compressed. The effect of this, unless there be great obstruction in the Eustachian tube, is to force air into the tympanic cavity. If the auscultation tube be used during this operation, the current of air is distinctly heard to strike against the membrane, and inspection of the latter shows an alteration in its curve, and very often injection of its blood-vessels.

(*c*) *Catheterisation.*—To introduce the Eustachian catheter, it is held between the thumb and forefinger and passed quickly but lightly along the floor of the nose with the point downwards, till this touches the posterior wall of the pharynx; the instrument being rotated outwards, is withdrawn till the point is felt to pass over the rounded projection of the posterior lip of the Eustachian tube, when a further slight rotation upwards, and a gentle onward pressure, will cause it to enter the orifice of the tube (Politzer). Another plan consists in withdrawing the catheter till the curve is felt to ride over the soft palate; the point is then turned upwards and outwards as before (Grüber). A third is to turn the point of the catheter inwards, and withdraw it till the beak hooks round the posterior edge of the nasal septum. The catheter is then rotated downwards and outwards, describing rather more than half a circle, when the point is usually at the mouth of the tube (Löwenberg).

When the catheter has been introduced, it can be retained *in situ* by being held between the thumb and index finger of the left hand. If the use of both hands is required, the catheter may be held in position by Bonnafont's nasal clamp. Air can be injected into the tympanic cavity either by the mouth, or by means of an india-rubber bag fitted accurately to the catheter. Force must be carefully avoided in introducing the instrument, lest the point should lacerate the mucous membrane, and a dangerous emphysema of the neighbouring parts result on inflation. Sometimes, owing to an obstruction in the inferior meatus, the catheter cannot be introduced; in such a case it must be bent to a greater curve and passed through the other nostril. During inflation, valuable information may be obtained as to the condition of the Eustachian tube and of the tympanic cavity by means of the auscultation tube. In the normal state of the middle ear, the sound heard is of a distinctly blowing character. If the mucous membrane is abnormally dry, while the Eustachian tube is patent, the sound is harsh; if the tube is narrowed, the air passes through with difficulty and is but faintly audible; if fluid is present, either in the tube or tympanic cavity, a bubbling or gurgling sound may be heard; and lastly, if the membrana tympani is perforated, the air is heard to hiss and whistle through the perforation. The patient's hearing should be tested before and after inflating the tympanum, either with a watch or by Politzer's *acoumeter*. The condition of the auditory nerve and labyrinth should next be investigated by means of the tuning-fork (*see* DEAFNESS), and lastly the nasal and pharyngeal cavities should be explored (*see* NOSE; PHARYNX).

Among the affections of the EXTERNAL EAR the following are the most important:—

a. Eczema.—This occurs both in the acute and chronic forms. Sometimes it is primary, at others an extension of an eczematous condition of the face and scalp. Seldom affecting the entire auricle, it is often seen on the posterior surface or in the fossa of the helix. When eczema spreads into the external meatus, it may cause deafness by the swelling of the lining membrane, and by the accumulation of epidermic scales.

Treatment.—When the attack is confined to the auricle, the same treatment as for eczema elsewhere should be adopted; but when the disease involves the meatus, liq. plumbi subacetatis should be instilled into the ear during the early stages. Later, the epithelial accumulations should be wiped away by means of dry cotton-wool, and the surface brushed over several times with a concentrated solution of nitrate of silver (Argenti nit. ʒj. ad aq. f℥j.), and after this treatment, to avoid relapses, anointed for some length of time with Unguentum hydrarg. subchlor. (ʒj. ad ℥j.).

β. *Hæmatoma Auris* consists of an effusion of blood between the cuticle and perichondrium on the anterior surface of the auricle. It may occur spontaneously or as the result of injury. It is of a bluish-red colour, hard to the touch and rarely fluctuating. When traumatic there may be pain, and a feeling of heat and fulness in the ear; when spontaneous, it is painless. It is not unfrequently found among the insane. This affection is best treated by cooling lotions, such as Goulard water, or by cold compresses. When pain, if present, is unrelieved by these remedies, the hæmatoma may be incised and the contents turned out, and a dressing of a weak solution of boracic or carbolic acids and compresses applied.

γ. *Diffused Inflammation of the External Meatus.*—This lesion is rare except as the result of injecting irritating substances, or mechanical and traumatic causes. The symptoms are: great redness and painful swelling of the cutis, with sense of fulness in the ear, followed by a serous or viscid exudation, On examination, the epithelial lining looks whitish and sodden, and, on syringing, comes away in flakes and even as an entire cast of the passage. The hearing is, as a rule, normal or only slightly impaired; occasionally the patient complains of noises in the head, and even of giddiness. Sometimes the meatus is so contracted by the swelling that it is impossible to get a view of the deeper parts. The pain is often violent, and is increased by pressure on the ear or movement of the jaw. When very severe, the inflammation sometimes terminates in perforation of the membrana tympani, or in ulceration of the osseous wall and the production of granulations. The diagnosis of primary otitis externa is difficult, where an uninterrupted view of the whole meatus and membrana tympani cannot be obtained. The prognosis is usually favourable, but is less so when the membrane is perforated, or when granulations exist. When the osseous walls are carious, there is danger of the inflammation spreading to the cranial cavity.

Treatment in the early stages should consist in the application of cold compresses over the ear, and a leech or two to the tragus; and as soon as secretion is established, the instillation of a warm alcoholic solution of boracic acid (gr. x. ad f℥j.) or liq. plumbi subacetatis and glycerine, equal parts. When the attack is obstinate, the meatus may be painted with a solution of nitrate of silver (ʒss. ad aquæ f℥j.), or powdered boracic acid may be blown into the ear.

δ. *Circumscribed Inflammation of the External Meatus. — Furuncules.* — The symptoms of this affection are usually very marked; there is great pain, often radiating over the side of the head, increased by pressure on the auricle and movement of the jaw. At first the hearing power is normal, but later there is often deafness. On examination one or more circumscribed swellings are observed, sometimes nearly closing the meatus; these are not generally reddened, but are exquisitely tender when touched. Eventually the abscess bursts and the pain subsides, often, however, only for a time, as no sooner has one furuncule run its course than another appears. In severe cases there is considerable febrile disturbance, and where there is a succession of furuncules, the patient is greatly exhausted by pain and sleeplessness. Notwithstanding, the prognosis is good, any permanent impairment of hearing being rare.

Treatment.—At the commencement of the attack, hot fomentations should be applied, and a warm alcoholic solution of boracic acid instilled into the ear. When the meatus is much narrowed by the swelling, a plug of cotton-wool, soaked in equal parts of glycerine and laudanum, often gives great relief; and should the pain be very acute, a leech may be applied to the tragus. In the later stages, free incision should be made into the swelling, but if the incision be made too early it only relieves the pain for a time.

ε. *Otomycosis.*—This is a chronic inflammation of the external meatus caused by the presence of a vegetable fungus, generally belonging to the species of aspergillus. The symptoms are—pain, tinnitus, and slight impairment of hearing. On examination a serous discharge is observed, and the membrana tympani and adjacent walls of the meatus are covered with a yellowish-white or black spotted membrane, and, on removing this by syringing, the tympanic membrane and meatus are found reddened and swollen.

Treatment consists in frequent syringing with warm water or weak carbolic acid, and then filling the meatus with an alcoholic solution of boracic acid. Occasionally the aid of forceps is required to remove the fungus. Other remedies recommended are: chlorinated lime (gr. ij. ad aq. f℥j.), and hyposulphite of soda (gr. iij. ad aq. f℥j.).

ζ. *Foreign Bodies.*—Children are especially fond of putting a great variety of substances into the ear. Among the commonest are: peas, beads, cherry-stones, and bits of slate-pencil. In cases of neglected otorrhœa, flies and maggots are also sometimes found. The symptoms will depend very much upon the size, shape, and character of the substance introduced. Inanimate bodies give rise to no symptoms beyond possible deafness, unless pressing unduly on the membrane or walls of the meatus. Peculiar reflex phenomena are, however, occasionally observed, to be explained by irritation of the numerous nerve-filaments derived from the trigeminus and vagus. Thus, cases are recorded of persistent cough, vomiting, sneezing, giddiness, and even epileptiform seizures, which have ceased on the removal of the substance.

Treatment.—Having ascertained the presence of a foreign body, its removal should first be attempted by syringing in the usual way, or, this failing, with the head inclined downwards. Should syringing be unsuccessful, instrumental means must be tried. The form of instrument will depend much on the shape and size of the foreign body. Speaking generally, the most useful instrument for the purpose is one with a fine, blunt-pointed, hooked extremity. The surgeon should endeavour gently to insinuate this in the gap between the body and the wall of the canal, and special care must be taken not to drive the body deeper into the meatus. If the object is long and lying across the canal, it can most readily be removed by means of a fine pair of forceps. Failing other means, Löwenberg proposes applying to the object a small brush dipped in glue, and withdrawing it when the glue has dried. Syringing alone will not remove maggots; they must first be killed by dropping alcohol, chloroform, or olive oil into the ear. If the ear be inflamed from the presence of a foreign body, or by previous injudicious attempts at its extraction, the inflammation must be subdued prior to any operative measures being attempted.

Obstruction or Narrowing of the External Meatus.—Occasionally this canal is closed by membranous septa or cicatricial adhesions. These may be caused by the coalescence of granulations, or ulceration resulting from caustic substances, syphilis, &c., or by the continued contact of the abraded and thickened surfaces of the cutaneous lining.

Treatment consists in dividing the septa or cicatrices and introducing sponge-tents or cotton-wool plugs, to prevent union of the cut surfaces. More common than complete obstruction is narrowing of the canal. This may be congenital, or the result of inflammation or hyperostoses. Lastly, in old people, the external orifice may be reduced to a mere vertical slit, due to an over-flaccid condition of the fibrous tissue and skin of the cartilaginous canal. This condition rarely causes any appreciable deafness; should it do so, the introduction of a small silver or india-rubber tube will restore the hearing. *See* Aural Exostoses.

Injuries to the Ear.—Injuries of the external meatus affect the osseous more frequently than the cartilaginous portion; lesions of the latter are generally combined with those of the auricle. The osseous portion may be fractured by direct violence, as by some object being forcibly thrust against it; or by indirect violence, such as a blow or fall on the ear or head, or a blow on the lower jaw, driving the articular process against the walls of the meatus. Uncomplicated fractures either terminate in recovery or in caries and necrosis. More generally, however, they are complicated by injuries to the membrana tympani and tympanic cavity, the mastoid process, and even to the base of the skull. When the roof of the tympanum is implicated in the fracture, fatal meningitis may ensue. The membrana tympani may be injured by direct penetration of foreign bodies, by extension of a fracture of the base of the skull, or by sudden condensation of air in the meatus, such as occurs in a violent explosion. The prognosis in cases of injuries of the ear will depend on the complications which exist; thus a ruptured membrane will, in the majority of cases, quickly heal, with little or no impairment of hearing, provided the labyrinth be not involved in the injury. While, on the other hand, if the labyrinth is involved, the prospect of recovered hearing is extremely doubtful.

Treatment.—Injuries of the auricle and soft parts of the external meatus should be treated on general surgical principles. In rupture of the membrane, the introduction of fluids into the ear should be carefully avoided, unless suppuration is established. In most cases the membrane will speedily heal, but if inflammation ensues, cold compresses may be applied, and a leech or two to the tragus.

A. E. Cumberbatch.

EAR, INTERNAL, Diseases of the. The symptoms of disease of the internal ear are mostly subjective, and, where no lesion of the tympanic cavity affecting the labyrinth is present they are generally included under: (1) Deafness, (2) Tinnitus, (3) Giddiness or Auditory Vertigo, and (4) Nausea and Vomiting. Other symptoms, such as hearing a double sound, hyperæsthesia, &c., may be met with, but they are so rare that they do not require further notice here.

(1) *Loss of hearing*, when the acoustic nerve is involved to a marked extent, is shown by the acuteness being lessened both to aërial and osseous conduction, the latter being the test on which we mostly rely. If a nerve responds to a sounding fork by osseous conduction better than by aerial, and, compared with a normal ear, is equally or more sensitive by bone-conduction, the cochlear structures corresponding to the tone of the fork employed may be considered healthy. *See* DEAFNESS.

Cases arise in which the range of audition is limited either by congenital non-development or by disease, and this can only be determined by the use of numerous differently toned forks. Such cases are probably not rare in general nervous diseases, such as tabes dorsalis; but few investigations have been made on the point, and, as they are at present of more interest to the specialist than the general practitioner, they need not be further dwelt upon.

(2) *Tinnitus*, which may be continuous or intermittent, of all characters, localised in the ear, or extending over the cranium, is due to irritation of the acoustic nerve. It may be the only symptom present, but that is not usual.

(3) *Giddiness*, or *Auditory Vertigo*, is rarely followed by unconsciousness, comes on suddenly, causes the subject thereof to fall forwards or backwards, or to reel to one side. It is due either to labyrinthine pressure, or to reflex cerebellar irritation.

(4) *Nausea* is frequently associated with the above, but is not so common as any of the others.

It must be remembered that any of these manifestations may occur from changes outside, but acting upon, the labyrinth; and that the diagnosis can be effected only by the comparison of the perception of the bony with the aërially conducted vibrations, the history of the attack, the presence of any of the usual causes of labyrinthine affection, the symmetry of the loss, and the absence of any other change sufficient to cause a temporary impairment or abolition of function.

The *Causes* of the above symptoms are very numerous.

General Diseases of the System, and more especially the zymotic diseases, scarlet fever, variola, mumps, typhus, diphtheria, typhoid fever, either affecting or not affecting the middle ear, may cause such a condition of hyperæmia of the labyrinth that changes of a temporary or lasting character are induced. To anæmia, degenerative affections of the liver or kidney, disorders of the digestion, pregnancy, lactation, and menstruation, have been attributed prejudicial influences on the internal ear. But of all the general diseases causing abeyance or annihilation of the cochlear function, syphilis, either congenital or acquired, is the most frequent.

Acquired Syphilis is generally preceded by some mucous membrane affection of the ear, but it may attack the internal ear suddenly. It occurs in the secondary or tertiary stage, usually affects both ears, and commonly produces the three great internal ear symptoms—deafness, tinnitus, and giddiness. The worst cases of internal ear affection arising from this cause seen by the writer have been marked by the absence of severe secondary symptoms, and the accompaniment of retinal changes.

In *Congenital Syphilis* the external affections of the ear are ordinarily preceded by affections of the external tunics of the eye, and the malady of the cochlea is generally heralded by visible choroidal and retinal changes. *See* CONGENITAL SYPHILIS.

The origin of the malady may arise *in the cranium*, either from vascular changes therein, such as aneurism of the basilar or internal auditory arteries, atheroma, emboli, or hæmorrhages; or from obstruction in the venous circulation of the labyrinth, through changes in the superior petrosal sinus or other venous channels passing from the skull. Meningitis, cerebral or epidemic cerebro-spinal, cerebritis, apoplectic conditions, tumours, or abscesses may, and do, cause alterations at the auditory centres, in the course of the portio mollis, or in the labyrinth. Many *medicinal substances*, especially quinine, opium, alcohol, and salicine, produce abnormal conditions of the labyrinth, followed by tinnitus and deafness.

Diseases of the Middle Ear, by causing a rapid or continued pressure on the labyrinth, either directly on the fenestral membranes or by indirectly initiating reflex vasomotor labyrinthine changes; or, as in purulent middle-ear disease, by inducing caries or necrosis of the walls thereof, may effect a transient or permanent alteration of the delicate structures therein contained.

Sudden loud and unexpected noises, such as the firing of heavy artillery, or continuous and repeated concussions, as in boiler-making, often give rise to enervation of the acoustic, by causing a congested condition of the parts. Any condition, by which an excessive or decreased tension of the fluids of the labyrinth arises, will act prejudicially on the fragile membranes therein contained, and cause a diminution of the acuteness of hearing.

A primary affection of the internal ear, in which all the symptoms usually found are present, without marked cerebral, spinal, or middle ear complications, has been described by M. Menière, and received his name. The sufferer is attacked by sudden giddiness, causing an inclination to fall in one particular direction, accompanied by nausea, retching, pallor, and sweating. These may be attended with deafness and tinnitus at the time, or they may come on afterwards. Unconsciousness is rarely present, and the vertigo passes off while the tinnitus and deafness remain. These attacks generally return at varying intervals, each being succeeded by an increase in the deafness and the sounding, till even the latter is lost, and the acoustic insensibility is complete. When this occurs, the other symptoms may not return. The pathological conditions found have been accumulations of reddish lymph in the semicircular canals, without any recognisable cerebral lesion.

The *labyrinthine changes* found are numerous, and include the following, viz. tumours—fibro-vascular or cholesteatomatous—hæmorrhagic or serous extravasations, anæmic or hyperæmic conditions, suppurative inflammation, caries, necrosis, exostosis and non-development of the fenestræ, vestibule, semicircular canals, or cochlea.

Under the term *tinnitus aurium* are included all subjective noises causing an irritation of the nervus acousticus from whatever cause they arise. The kinds of tinnitus complained of are as varied as the causes assigned for them, and they may arise in any aural disease which produces a change of tension or of circulation, or an irritation of the acoustic directly. They may be occasioned reflexly by changes in distant organs, as in the stomach, liver, or teeth. The nerve may detect alterations in the muscular contractions of the muscles of the middle ear or Eustachian tube, or in the blood-flow through the vessels which surround it or supply it. These are, in reality, objective sounds, but are usually included among the subjective, and have been described as subjective entotic tinnitus.

The hallucinations of hearing of the insane are, in some cases, connected with peripheral aural disease, and disappear with the cure of that affection.

Deaf-mutism generally results from congenital non-development of the organ, or destruction of the hearing function, in children who have not yet learned to read. In the former cases heredity plays a weighty part, and, in these, the curtailment of the visual sense is frequently seen, especially *retinitis pigmentosa*, which should always be looked for in deaf-mutes, the offspring of consanguineous parents. The abnormal conditions found in the ear are complete absence of the labyrinth, non-development of the semicircular canals, absence of the fenestræ, or defective sound-conveying apparatus. It is found that 40 per cent. of such cases hear some sounds or even words, and it is the cultivation of this little remnant of hearing which has given rise to the boasted remedies for such sufferers.

Treatment.—It will be seen from the above that the causes of affections of the internal ear are not always discoverable, and that many which are recognised are beyond the skill of the surgeon. Of those which may be alleviated, the cases arising from middle ear affection stand first, and in these the local treatment of the affection is usually followed by amelioration or cessation of the labyrinthine symptoms.

In *hyperæmia* vesication over the mastoid process, by repeated applications of linimentum iodi or cantharides, local depletion of the stylo-mastoid supply by leeches or Heurteloup's artificial leech, combined with purgatives and abstinence from alcohol, tobacco, and excitement, are to be recommended.

In *anæmia*, fresh air, regular exercise, nourishing food, and the exhibition of ferruginous tonics embrace the treatment.

In *syphilitic affections* large doses of iodide of potass, and mercurial inunction, are frequently followed by diminution of the symptoms. Counter-irritation of the mastoid, and subcutaneous injection of from 5 to 10 minims of a two per cent. solution of the muriate of pilocarpine are advocated by some.

To relieve subjective tinnitus, bromide of potassium in 20-grain doses thrice daily, hydrobromic acid in 15 to 20-minim doses as frequently, and the chloride of ammonium in 10 to 20-grain doses have been found more useful than other internal remedies. Counter-irritation of the external meatus or mastoid, the injection of chloroform or sulphuric ether vapour through the Eustachian tube, the hypodermic injection of morphia, and the incising of the membrana tympani, have all been extolled, but, though sometimes beneficial, are generally found wanting.

In *acoustic paralysis*, the use of strychnia or phosphorus is occasionally serviceable. The continuous galvanic current has been often employed, and has met with varying success.

In *Menière's disease*, gentle purgatives, rest in bed, and slight counter-irritation to the neck, are all that are required for a short time. Should the symptoms continue, large doses of quinine—5 to 10 grains three times daily—are given by Charcot, while digitalis, the bromides, and the actual cautery to the mastoid, are employed by others.

In *deaf-mutism*, with the treatment of any lesion which can be detected, the education by lip-reading and the articulate speech system, which strengthens the organs of speech and breathing, and places the sufferer in a position in society far above what could have been hoped for before the system was introduced, is to be carefully carried out under experienced teachers.

W. Laidlaw Purves.

EAR, MIDDLE, Diseases of the.—*Acute Catarrh.*—Whatever causes acute congestion of the naso-pharyngeal mucous membrane, such as severe cold, the exanthemata, &c., may give rise to acute catarrh of the middle ear. The attack begins with a sense of fulness in the head followed by pain, which may be severe, though not usually so. There is dulness of hearing, which soon increases to more or less marked deafness. Sometimes tinnitus is present, and even giddiness, and in severe cases there is some febrile disturbance. On examination the meatus usually presents a normal appearance, or is but slightly congested superiorly, close to the membrane; it is rarely narrowed by subdermoid effusion. When the attack is slight, the membrane shows but little change beyond a dimness of its polished surface, but if more severe, there is redness of its upper posterior segment, or even of the entire surface. The cone of light is altered in position or may disappear. Sometimes the effusion of fluid into the tympanic cavity is so great as to cause bulging or even rupture of the membrane. When the latter occurs, the perforation speedily heals when the tension is relieved. The Eustachian tube is either narrowed or closed by the swelling of its lining membrane and by accumulation of mucus. The termination of the case will depend very much on the severity of the attack and the condition of the patient's general health. When mild the attack often subsides without treatment, but severe cases, if neglected, either end in the formation of an abscess or lapse into the chronic form of disease.

Treatment.—If the attack is not severe, confinement to the house for a day or two, astringent applications to the throat, and the use of Politzer's air-douche, will be sufficient to effect a cure. In severe cases, in addition to this treatment, a leech should be applied to the tragus and warm fomentations to the ear, or warm water with a little laudanum should be instilled into the meatus. If the membrane is distinctly bulging, great relief will be afforded by puncturing it with a double-edged cutting needle. When there is free secretion from the naso-pharyngeal cavity, a warm nasal douche (Boracis et Sodæ carb. āā gr. v. ad Aq. f℥j.) should be used for a few days.

Chronic Catarrh.—Various pathological conditions are included under the term chronic catarrh of the tympanum; but as in so limited a space it is impossible to describe all the symptoms met with, only a general description of the disease can be given. It probably never commences as a chronic affection, but is the result of repeated and slight subacute attacks, or of a single acute one. Even in the case of boiler-makers, engine-drivers, &c., a low form of inflammation is probably started by repeated concussions of the membrane. Constitutional syphilis, gout, rheumatism, gestation, and heredity are predisposing causes. The symptom generally first observed is hardness of hearing, particularly in general conversation; this is soon followed by tinnitus, although this symptom may be noticed by the patient before any difference in the hearing power is detected. The deafness often increases so gradually that it has probably been in existence some time before the patient notices it, especially when one ear only is affected. The hearing power varies in many cases with the state of the weather and the patient's health, being worse in cold damp weather or after fatigue; pain is rarely present, and is never severe. Sometimes the patient complains of giddiness, or actually falls when walking, and this even where there is no proof of organic lesion in the labyrinth. Sometimes there is a sense of tightness in the head, and a feeling as of the ears being closed by some foreign body. In certain cases patients can hear better in a noise, as when driving in a cab or railway carriage. On examination the meatus appears dry and shining; occasionally it contains impacted cerumen, the removal of which, however, does not improve the hearing. The appearance of the membrane varies greatly; sometimes unaltered, it more generally is whitish or brownish in hue. No congestion is visible, unless a slight subacute attack be present.

At times the anterior segment is depressed, in which case the handle of the malleus is sharply defined; at others the entire membrane is depressed and the handle of the malleus is tilted backwards and inwards. Opacities, calcareous deposits, and thin spots, the result of atrophy of the membrane, are occasionally seen. The cone of light becomes more horizontal, or is broken into one or more points. Rhinoscopic examination may show the Eustachian tubes obliterated by cicatricial bands, variously distorted and drawn out of place, or simply narrowed. The pharyngeal mucous membrane is swollen and congested, granular, or dry and pallid; in children adenoid vegetations in the roof of the pharynx are often found. The prognosis of chronic catarrh is not altogether favourable. Much depends on the age of the patient, the duration of the disease, and the liability to frequent subacute attacks. If the patient is gouty or rheumatic, if deafness is hereditary, or if the disease has extended to the labyrinth, the prognosis is unfavourable. Patients who hear better in a noise, in the writer's experience, never improve under treatment.

Treatment.—The nose and pharynx must first be thoroughly investigated, and, where necessary, restored as far as possible to a healthy condition (*see* NOSE; PHARYNX), and any disorder of the general health rectified. Astringents should be applied to the throat in the form of spray, lozenge, or gargle, and the tympanum inflated every third or fourth day, by means of Politzer's bag or the Eustachian catheter. In the writer's experience, the introduction of lotions and vapours into the tympanic cavity is very rarely of any benefit, and frequently does harm; while making an artificial opening in the membrane, incision of the posterior fold, division of the tensor tympani, &c., are operations to be undertaken only by experts, and are rarely attended with success. Under appropriate treatment some cases of chronic catarrh are greatly improved and others slightly so, whilst a large percentage unfortunately derive no benefit. Some cases improve for a time under treatment, but relapse as soon as this ceases.

Acute Purulent Catarrh is separated from the non-purulent variety, mainly for clinical convenience. It arises under the same conditions, and the symptoms of the two are undistinguishable at first; indeed, it is often impossible to say, at the outset of an attack, whether it will end in suppuration or not. In the suppurative variety the symptoms are generally more severe, and the pain greater. After a while the abscess bursts through the tympanic membrane, and the pain subsides or ceases. Examination of the ear, after cleansing, discovers a perforation in the membrane, which is usually single, but may be double. At first irregular in shape, it soon becomes more or less circular, and varies greatly in size and in situation. The epithelial lining of the meatus and tympanic membrane is whitish, sodden, and often shed in places; where this has occurred, the dermis is of a bright red colour. Occasionally, owing to some abnormality of the meatus or to the swelling of its walls, the perforation cannot be seen; when such is the case, the peculiar whistling sound heard on auscultation, during inflation of the tympanum, will prove the existence of a perforation.

Treatment.—The patient should be confined to the house at first, and a simple saline aperient administered. The pain should be combated by hot or cold compresses and warm instillations, or, these failing to afford relief, by leeches applied to the tragus. Politzer strongly recommends the application to the side of the head of a piece of cotton-wool, sprinkled with a mixture of equal parts of olive oil and chloroform. When the throat is affected, as is usually the case, an astringent gargle should be ordered, or the throat painted with nitrate of silver (Argenti nit. gr. xv. ad Aq. f℥j.) or chloride of zinc (Zinci chlor. gr. xx. ad Aq. f℥j.) If the membrane is distinctly bulging, immediate relief is afforded by incising it, and so assisting the escape of matter. When there is swelling and tenderness over the mastoid process, which are not relieved by leeching, a free incision may be made down to the bone. After the first severity of the attack has subsided, the ear should be syringed night and morning, and some astringent lotion used. (Some of the most efficient lotions for this purpose are Zinci sulph. and Acidi boracici āā gr. iv. ad Aq. f℥j.; Acidi boracici gr. x. ad Alcohol f℥j.; Liq. plumbi subacetatis and Alcohol, equal parts; Zinci sulph. gr. v.; Acid. carbol. gr. ij. ad Aq. f℥j.) Inflation by Valsalva's or Politzer's method, previously to syringing, will greatly facilitate the removal of the discharge from the tympanic cavity. This inflation serves also to preserve the patency of the Eustachian tube.

Chronic Purulent Catarrh.— This affection is the result of the previous acute form, and is very common in young people. The discharge is often profuse and offensive. The perforation in generally large, and at times almost the entire membrane is destroyed, in which case the malleus and incus have disappeared. The mucous membrane of the tympanic cavity can be seen, red and swollen. Often polypi are present, either springing from the cavity or from the meatus, or both. If the perforation be small, and the membrane is denuded of epithelium, red, and œdematous, this may be easily mistaken for a polypus.

Treatment.— The ear must be kept scrupulously clean, being syringed two or three times a day, according to the copiousness of the discharge; after each cleansing, the meatus is to be dried, and powdered boracic acid blown into it. (The barrel of a quill, with a piece of india-rubber tubing attached, makes a very convenient apparatus for this purpose.) If powdered boracic acid fails, some astringent lotion should be tried, and where the mucous membrane of the tympanic cavity is much swollen, absolute alcohol is the best application. This should be diluted, at first, with an equal quantity of water, and gradually increased in strength. Inspissated pus clogging the meatus and tympanum, and not readily removed by syringing, may first be softened with a warm solution of carbonate of soda (gr. x. ad Aq. f℥j.) Narrowing or obstruction of the Eustachian tube must be dealt with by means of Politzer's bag or the catheter.

The Artificial Drum.—After curing the purulent catarrh, should the perforation not close, and marked deafness remain, the hearing may often be greatly improved by means of the artificial drum. Without stopping to discuss the *modus operandi* of this drum, it may be stated that there are two varieties, Yearsley's and Toynbee's; all others are but modifications of these. The former is made by moistening a piece of absorbent wool and rolling it into a thin plug, about an inch long. This is passed, with a pair of forceps specially made for the purpose, till it is in contact with the membrane. When the right spot is discovered, against which the plug should press, the patient is at once conscious of an improvement in his hearing. Several trials are usually required before success is attained. Toynbee's drum consists of a thin circular disc of india-rubber, fastened to a piece of silver wire, long enough to allow the disc to reach the membrane, the disc being cut of the requisite size and shape before introduction. When a satisfactory result is obtained, the patient must be instructed how to adjust the drum for himself. The cotton-wool has the advantage over the india-rubber of being less irritating to the ear, and can be moistened with various astringents in cases where the discharge has not quite ceased; but, if used, it must be changed daily.

Complications.—Various complications may arise in the course of chronic suppuration of the middle ear. I. Polypi. II. Mastoid disease. III. Caries and Necrosis. IV. Meningitis and Cerebral Abscess. V. Phlebitis and Pyæmia.

I. *Polypi.*—These may arise during an attack of acute inflammation of the meatus, but more frequently during chronic purulent catarrh of the middle ear. They usually spring from the tympanic cavity, the membrana tympani, or the external meatus. Varying in colour from greyish-pink to bright red, smooth or raspberry-like on the surface, pedunculated or sessile, they vary greatly in size.

Treatment.—Small polypi, arising in the external meatus, can be readily extracted with a small pair of urethral forceps; when larger, with Wilde's snare. Those arising in the tympanic cavity may be removed with various instruments; but, on the whole, Wilde's snare is the best. Fixing the patient's head, insert the largest speculum possible, and throwing a strong light on the ear, pass the loop of wire over the tumour, till the resistance due to the wire reaching the pedicle is felt, and then cut through the growth. Should there be a difficulty in severing the pedicle, owing to its toughness, it is better to rotate the instrument several times, and, dividing the wire close to the ear, withdraw the snare, rather than run the risk of snapping the wire by putting too great a strain on it; in a few days the tumour will slough. The simplest method of removing a large firm polypus is to seize it with a pair of small dressing forceps, and twist it off at the pedicle by rotating the instrument.

II. *Mastoid Disease.*—This occurs in two forms: *a.* periostitis, *β.* muco-endostitis.

a. The symptoms are—great pain, often radiating over the side of the head, redness and swelling behind the affected ear, which often stands out more prominently than the other; there is also some febrile disturbance. After an interval, fluctuation can be detected. Occasionally the abscess bursts into the mastoid cells, in addition to opening on the surface. Sometimes the abscess will burrow beneath the muscles at the back of the neck, and may reach as far as the foramen magnum; at others it will track downwards beneath the sterno-mastoid muscle as far as the root of the neck.

β. This affection may be primary, although it is usually a complication of middle ear disease. The symptoms are deep-seated pain and tenderness only on making firm and prolonged pressure; swelling and redness are not marked symptoms, and may be absent. When severe, indications of cerebral irritation may exist, such as giddiness, tinnitus, squint, vomiting, &c. Sometimes the abscess makes its way through the mastoid process; at others it bursts into the cranial cavity. Rarely, instead of an abscess forming, the inflammatory products ossify, and the mastoid cells are converted into solid bone (osteo-sclerosis.)

Treatment.—If matter can be detected, the abscess should be freely opened; but if not, leeches should be applied to the mastoid process, and these failing to afford relief, an incision down to the bone must be made. Sometimes the meatus is much narrowed by œdema or by the pressure of matter which has burrowed posteriorly beneath the periosteum; in either case the right treatment is free incision. The discharge from the tympanum should be encouraged for a time by hot fomentations and syringing with warm water, and if a polypus be present it should be removed without delay. Should symptoms of brain-mischief supervene, the mastoid process must be trephined; in doing this, great care must be taken to avoid wounding the lateral sinus.

III. *Caries and Necrosis.*—This is also another not uncommon complication of chronic suppuration. Almost any part of the temporal bone may be attacked; the mastoid process, the tympanic cavity, the meatus, the boundary wall of the lateral sinus, or the petrous portion containing the labyrinth. Often the diagnosis is readily made, as when the mastoid process, or posterior wall of the meatus, is affected; but when the deeper parts are involved, it may be impossible to ascertain, with certainty, the presence of dead bone, although this may often be suspected. There are no special symptoms indicating dead bone, but paralysis of the portio dura in the course of a chronic purulent catarrh, a watery and offensive discharge, and polypoid granulations in the ear, resisting treatment, are all suspicious signs. Where it can be done with safety, dead bone should be removed.

IV. *Meningitis and Cerebral Abscess.*—Cerebral abscess has been found, *post mortem*, in cases of otorrhea, where no sign of caries or necrosis could be detected. More frequently, however, a diseased condition of the temporal bone is the exciting cause. When, in the course of purulent middle-ear catarrh, there is a rise of temperature, with headache, photophobia, optic neuritis, and vomiting, there is strong presumption that intracranial mischief has supervened, the symptoms of which need not here be further detailed. *See* ENCEPHALITIS.

A. E. CUMBERBATCH.

EBURNATION. *See* OSTEO-ARTHRITIS.

ÉCRASEUR.—This is an instrument for removing growths or diseased parts by the gradual tightening of a loop of wire or other material. The parts are crushed through, and vessels of considerable size may be divided without any hæmorrhage whatever. The essential part of the instrument is a loop of wire, wire rope, or chain, which can be reduced in size by a mechanism in a suitable handle. The ends of the loop are passed through a canula, or an eye at the end of the handle. Thence the wires are conducted to the handle, one end being attached to a fixed point, the other to a button connected with a screw, by turning which the wire is drawn down, the loop diminished, and the encircled parts constricted and divided. The length of the canula and handle and the play of the movable button will depend upon the size of the loop required, and the depth of the cavity in which the growth is situated.

Two modes of reducing the loop are in use—one, as mentioned above, where by the turning of a screw the movable end of the wire is drawn down, and the other a rack movement. The handle in the screw form is a revolving bar or wheel; in the rack form a bar working by a side-to-side tilting movement, which tightens the chain link by link. Where the part to be removed can be surrounded, as in a pedunculated tumour, the loop is either placed over the growth, or one end guided round the pedicle. Where this cannot be done, as in removing portions of the tongue, the wire is carried through at the desired point or points by a needle or canula, and the parts severed in one or more places. The loop may be prevented from slipping by transfixing the part with stout harelip pins, or a sort of pedicle formed by dividing the mucous membrane, for example, at the side of the tongue. The loop must be tightened slowly, and after every few turns the action must be for a few moments stopped altogether, to allow time for coagulation to take place, and for the slower division of the parts. In this way no hæmorrhage need occur at all, and the wire is less liable to break.

Somewhat modified, the écraseur is used in removing polypi from the ear and nose, the instrument being called a snare.

CHARTERS J. SYMONDS.

ECTHYMA.—At a time when skin-diseases were regarded solely as forms of eruption, without taking fully into consideration their other important features, ecthyma was regarded as a definite pustular disease. This is, however, no longer the case, and the name 'ecthyma' might with advantage be dropped out of our nomenclature. It is, however, still used to indicate a large pustule, forming a conical scab, and somewhat resembling a superficial boil. It is met with among the poor and badly fed, in such diseases as scabies, phthiriasis, and eczema.

ROBERT LIVEING.

ECTOPIA VESICÆ and EPISPADIAS. — The peculiar deformity of the bladder here treated of is always attended by a deficiency of the anterior or upper wall of the urethra, constituting the deformity of epispadias. Slighter degrees of the latter deformity are frequently found without the ectopia, but all the cases of *ectopia vesicæ* in the male which the writer has seen, amounting to between sixty and seventy, have been coexistent with epispadias. Many of these cases have been present in sickly-looking children and youths, not infrequently the subjects of tuberculosis. The proportion of females to males is very small —not more than one in ten cases.

Sometimes there are evidences of degeneration of the kidneys similar in its pathology to the ordinary surgical kidney, with cystic degeneration, and dilated pelvis and ureters. This condition is brought about by granular growths on the mucous membrane of that portion of the deformed bladder upon which the ureters open, causing obstruction to the flow of urine. The papillary orifices are irritated and inflamed by the friction of the clothes, and often present a warty appearance, with a rough surface discharging muco-pus, a condition resembling somewhat that of granular conjunctiva induced by entropion in the eyelids. These growths and thickening of the papillary orifice produce the ordinary effects of obstruction in the urinary passages, first shown by dilatation and hypertrophy of the ureters, and secondarily affecting the pelvis of the kidney. Sometimes a muco-purulent secretion issues from the orifice. In these cases a degree of albuminuria greater than is accounted for by the local cystitis is found.

But frequently no such signs of the condition of the secreting structure of the kidney are to be found, and great circumspection is required before the surgeon should attempt to relieve this deplorable condition of the patient by operation. In the experience of forty cases operated on by the writer, a fatal result chiefly from this cause, previously undetected, has occurred in four cases.

The condition of *ectopia vesicæ* is perfectly compatible with life prolonged to a considerable length, and even, it is said, with the power of procreation. The writer has seen cases in which the patient has reached the age of fifty to sixty years. Females thus affected have, in some cases, borne children.

Not uncommonly the sex of the patient has been mistaken, and partly from this error, and partly from the greater convenience of the dress, the miserable patient has been brought up as a female—the smallness of the testes, placed in a large labial fold of skin, leading to ignorance of their presence and meaning. This serious mistake is further promoted by the great width of the hips, and the waddling gait induced by the pelvic deformity, and by the feminine mode of micturition rendered necessary by the open bladder, in cases where the urine is retained for a short time in the dilated ureters.

The patient is usually first seen by the surgeon during infancy or childhood. In the hypogastric region the site of the *mons veneris* is occupied by a red vascular-looking projection, presenting a mistakable similarity to a nævus or malignant tumour, and reaching down to and involving the dwarfed and epispadiac penis. In the female it ends in a split clitoris, and merges into the *labia minora* on each side. But it will be observed that, when the child coughs or cries, the tumour will become tense and protrude in the way of a hernia, and probably a spurt of urine may jet out of two prominent conical elevations at the lower part, just above the stunted penis. When the jet is decided, this indicates always a certain amount of dilatation of the ureters. The jet of urine may also be produced by depressing the penis and thus clearing the uretal orifices. It will be noticed, also, that there seems to be a total absence of the navel cicatrix, rendering the upper and middle regions of the abdominal wall very peculiar in appearance.

Careful examination will show that just on the upper margin of the red protruding mass is a crescentic border of cicatricial tissue, which really represents the upper or omphalo-mesenteric part of the umbilicus. Above this will be seen and felt, in the median line—especially when the recti abdominis are put into action—a flat surface, hard and resisting, of from an inch to two or even three inches wide, bounded on each side by the recti muscles, and tapering upwards to the ensiform cartilage. This is the widened and expanded linea alba, and the structures covering the peritoneum here are sometimes very thin, although tough and resisting. The skin over this interrectal interval is smooth, and usually free from hairy growth. The recti are separated by the whole extent of the wide divergence of the superior rami of the pubes from the median line.

The penis is flattened out and stunted in length, and is applied closely to the lower surface of the exposed bladder between the uretal papillæ. On depressing it will be seen the urethral groove, showing the various urethral ducts and follicles, including those of the prostatic urethra. The prepuce is usually somewhat large, and depends like a dewlap, with the frænum preputii in the centre attached to the lower part of the corona of the glans penis. The scrotum is wide, shallow, and generally large, and often the testes are normally placed. But sometimes the dartos development is small and deficient, and the testes are in the groin. On each side of the penis and exposed bladder is seen an elevation or protuberance, which is caused by the forward projection of the pubic angles and their incomplete symphysial surfaces. Under the penis and below these projections can be felt a resisting ligament, which is found on dissection to be the strengthened and largely developed lower or suburethral fibres of the triangular ligament of the urethra. The subpubic ligament and upper or supraurethral part of the triangular ligament are, of course, wanting. Frequently there is found, on one or both sides, an oblique inguinal hernia, with the testis below, either in the scrotum or above it. This additional abnormality necessitates great care in dissecting up flaps while operating over the sac of the inguinal rupture.

The perinæum in these cases is short, and the anus placed somewhat more forward, and with a more anterior direction at the orifice, than is natural. The thighs are seen to be more separated from each other, and the pelvis and perineum wider than natural, giving an appearance and gait similar to that of a largely developed female pelvis. The pelvic skeleton in these cases is so peculiar that any of the bones forming it can be easily and separately recognised by the anatomist as affected by this deformity. The pubes are separated to the extent of from two to four inches, the superior rami shortened and directed forwards, and the obturator foramen diminished in size, narrowed, and turned outwards. The iliac bones are straightened out more than normal. The sacrum is very peculiar. The lateral curve, instead of being concave, is flattened out or even convex, with the ilio-sacral facets turned more outwards than normal, while the vertical curve is straightened.

The patient suffers much from the constant flow of urine, together with the friction of the clothing upon the exposed and inflamed surface of the bladder. When from errors of diet or hot weather the urine is rendered irritating, the suffering is greatly increased, and the unhappy patient is truly an object of commiseration and pity.

Treatment for the relief of ectopia vesicæ:—Some years ago Mr. John Simon proposed an operation for the relief of this deformity, which consisted in making a communication from the base of the imperfect bladder between the ureters into the rectum. The intention was to make this communication permanent, and then to cover the bladder entirely with skin. Mr. Lloyd also performed this operation upon a patient. The patients operated on in this way died without the permanent communication having been established, from extravasation of urine and peritonitis. Mr. Thomas Smith, in one case, detached the ureters from the bladder and passed them through an opening in the rectum, with the hope that they would become permanently adherent, and that the rectum would assume the functions of the bladder. This patient also succumbed to the irritation and diarrhœa produced by the constant presence of urine in the rectum.

It had been felt by surgeons since the modern revival of the art, that if a covering of skin could be provided for the bladder, the suffering would be much alleviated, especially if the flow of urine could also be directed over the grooved penis, and confined to that spot. Dr. Ayres, of New York, seems to have been the first to operate to relieve in this way a female patient in whom the clitoris was split and the vagina and bladder formed one large cloaca. He turned down a large flap of skin from the abdomen, with its raw surface uppermost, and endeavoured to get this to cicatrize and heal. The result was not very encouraging. Dr. Pancoast, of Philadelphia, tried in the case of a male patient to accomplish this end by turning over a lateral flap with its skin surface towards the bladder, and placed over it another lateral flap twisted so as to place its raw surface undermost upon the other. The surfaces adhered, but an opening remained upon the abdomen, above the flaps, through which the urine flowed, and this resisted all attempts to close it. Trouble was also experienced from the growth of hair into the bladder from the reversed flap. It was found in process of time, however, that the hairs finally ceased to grow, the bulbs being destroyed by the constant irritation of the urine. The operation does not seem to have been followed up in the United States by either of these surgeons or by others. Mr. Holmes, of St. George's Hospital, was the first to follow a modification of Pancoast's method in this country, in 1863, and in two of his cases was successful in making the patient more comfortable. About the same time the writer had his first successful case at King's College Hospital. His operation consisted in making lateral flaps of skin and uniting them, without reversal or superimposition, in the median line. Trouble was experienced in closing up the opening in the median line above the bladder, but after one or two unsuccessful attempts this was overcome, and the patient lived for nearly a year, wearing an india-rubber urinal comfortably, and then died of bronchitis. The parts were secured, and are now to be seen in the museum of King's College. The deep surface of the reversed skin, forming the new anterior wall of the completed bladder, is seen through an opening made in the hinder wall to be covered with smooth mucous membrane.

After several attempts, with variable success, the writer improved his operation in two directions—first, by having recourse to a reversed upper or umbilical flap, and by laying the two lateral transplanted flaps upon it. Since that plan was adopted, the upper opening, which formed at first such a difficulty, has been always closed by the first operation, or nearly so. But a fresh difficulty arose. From the constant hernia-like pressure of the abdominal contents upon the loose and flexible hinder vesical wall, the opening above the penis had a tendency to get larger and wider, and the bladder to protrude as the cicatrices contracted. To remedy this, a second operation, based upon M. Nélaton's operation for epispadias, was devised. The essential part of Nélaton's procedure was the raising of a bridge or double-rooted flap from the front of the scrotum below the penis, and passing the penis under this bridge so as to protrude below. A long narrow flap was reflected from the linea alba above, and laid over the grooved urethra with its skin surface downwards, and the bridge of scrotal tissue was then stitched upon it. The hair which afterwards grew upon the reversed flap from the site of the mons veneris, and blocked up the urethra, was a serious drawback to this method of procedure.

In the second or supplemental operation of the writer, the reflected flap for union with the superimposed scrotal bridge is obtained from the margin of the arch over the penis, formed by the union of the lateral or groin flaps, and the sides of the penile groove were also reflected so as to form a raw surface for the reflected flap to adhere to. The cases thus operated on, now amounting to forty in number, were rendered much more comfortable; and in one which was exhibited at King's College Hospital many times since, the patient has been successful in retaining the water for a short time when he lay down, by the use of an india-rubber nipple placed over the penis and the surgically-formed prepuce, so as to constrict them somewhat, and thus arrest the flow of urine. On coughing or sneezing powerfully, however, this is apt to slip, but answers its purpose on the whole pretty well. Other cases have worn an india-rubber urinal similar to that in use in railway travelling. Various modifications of this operation have been performed by different surgeons. A very successful one in a female child was lately published by Mr. Robson, of Leeds, in the *British Medical Journal*, January 24th, 1885.

The following is a description of the writer's operations for the relief of *ectopia vesicæ* and *epispadias*.

1. The first operation, i.e. for the *Ectopia*. The lower part of the abdomen and the genitals are first carefully cleaned and shaved. In cases where the hair is unusually abundant it is best, in the first instance, to remove it by some depilatory and by applying previously a drop of strong nitric acid to the several groups of hairs at

successive intervals, the bladder and other parts being carefully protected by a mixture of olive oil and chalk laid on freely. When the skin has healed, after the action of the acid, the parts should be well washed with a 2½ per cent. solution of carbolic acid, in which all the instruments used in the operation should be steeped. The patient being anæsthetised and laid flat on his back, the flaps should be marked out by a pen-and-ink mark.

The upper flap should be figured by a line extending along the side of the bladder-surface vertically upwards as far as the measured distance from the root of the penis to the upper margin of the bladder, and then carried in a rounded curve across the 'linea alba' at this point to join another vertical line of equal length on the opposite side of the bladder. The two groin flaps for superposition are to be made of a rounded lancet-shape, with their roots downwards and inwards at the base of the scrotum, and continued along the side of the urethral groove for about half its length. These flaps should be long enough and detached enough to meet in the median line for their whole length, and no sharp angles should be left in their outline. The incision for making them should join that of the lateral border of the first or umbilical flap at about its centre. In raising the umbilical flap, care must be taken not to make the skin too thin, which is apt to be done in the centre of its base near the upper margin of the bladder. At this point there is little or no subcutaneous tissue, and the aponeurotic and tense linea alba is thin and easily injured by the knife, consequently the greatest care is required to avoid opening into the peritoneum or subperitoneal fascia. This accident, in one case in Paris, under M. Follet (a pupil of Nélaton's), caused the death of the patient from peritonitis. The urine could not be prevented from passing afterwards into the wound.

It is better to lay hold of the flap with the fingers than to use the forceps, which are apt to damage the vitality of the edge of the flaps, upon the direct union of which a good deal of the success of the operation depends. In raising the lateral or groin flaps the superficial external pudic vessels are divided, and are often large enough to require ligature. After being raised the flaps should be folded back, so as to lay bare the raw surface, which should be suffered to become glazed, after all bleeding has ceased, and all clots are removed with a saturated solution of boracic acid in the form of spray. The upper or umbilical flap should first be dealt with, folded evenly down with its skin surface to the bladder, its corners being stitched with thickish wire sutures to the cut edge at the root of the penis on each side. The ends of the wire should be left so long as to project, with a view to their easy removal. A single half-knot tied on them in the usual manner, and held by a sharp bend back at both ends, is the best way of securing the wire (the thickness of which should be enough to hold the bend or kink without untwisting). The groin flaps should then be placed upon the raw surface of the umbilical flap, with their inner edges held in contact along their whole length by six closely-applied wire sutures. The bases of these flaps should pretty closely embrace the root of the penis. The raw surface left by the reflection of the umbilical flap can be easily covered by drawing its edges together with three or four strong and long harelip pins, which have the effect of relieving any strain which may affect the reflected flaps. At this stage of the operation the patient's shoulders should be well raised and his knees bent and adducted, to diminish the stretching of the abdominal parietes. The upper borders of the groin-flaps may be held upwards by one or two thick wire sutures, but the site of the groin flaps should be left to heal by granulation.

During the operation the knife should be kept carefully in hand, especially if a cough or uneasiness under chloroform affects the patient and causes sudden bulging of the bladder. The latter should be repressed by holding a soft sponge firmly upon the flaps. This pressure has the additional advantage of squeezing out the urine and causing the sticky, glazed surfaces of the flaps to adhere together. On being removed to bed, the patient must be kept doubled up, and never allowed to stretch himself out. He should be placed on a waterproof in a sitting posture, with his shoulders well propped up behind, a thick bolster under his knees, and a bandage passed round the knees and over and across the shoulders and back, to maintain the flexed position while being removed. The wounds should be painted over with collodion, and a few drops of oil put into the urethral opening, to spread over the bladder surface and promote the free passage of urine.

In the female the umbilical flap should be large, and the incision for the groin flaps on each side should be carried well down, so as to have their roots in great measure connected with the labia. When they are placed together and stitched upon the umbilical reversed flap, the vagina should be almost closed up by them, with but a small opening to allow the passage of the urine. Through this opening a very large india-rubber drainage-tube should be kept in the vagina, and be changed and cleaned daily.

As the cicatrix contracts in the male patient, the urethral opening may become considerably enlarged by the hernia-like protrusion of the hinder wall of the bladder, already alluded to, distending the aperture and depressing the penis. This change may be accelerated by repeated coughing or crying on the part of the patient. But the bladder and uretal openings are more or less effectively protected, by their deepened position, from the friction of the clothes.

As a supplemental procedure in the male, the following operation for the *epispadias* which remains, and for a preputial covering for the penis, will usually be found necessary:—

2. *Operation for Epispadias*, modified from that practised by Nélaton.

The patient must first have all the hair-bulbs, which are likely to give trouble afterwards by growing into the urethra, destroyed by strong nitric acid, as before described. When the skin is sufficiently healed, the parts must be carefully cleansed by washing wth a 40 per cent. solution of carbolic acid. The patient being anæsthetised, and placed flat on his back on the operating table, the surgeon makes an incision parallel to and half-an-inch above the arched cicatrized urethral border of the covering of the bladder, and then turns down by dissection a fold of the skin, with its skin surface placed upon the penis. The incision should be carried well along the sides of the urethral groove, so that the side of the penis is well denuded, and the urethral groove completely covered by the meeting of the inverted flaps in the median line. A cold soft sponge is pressed firmly by the assistant upon the bleeding surface with the penis firmly stretched out.

Then another curved incision is made below the root of the penis at the junction of the penis and scrotum, meeting the incision already described on each side. A third curved incision is then made along the lower border of the scrotum, longer than the former and with a downward projection in the middle to form the point of the prepuce. The intervening skin of the scrotum is then dissected up from the testes, leaving the bridge of skin, with pedicles three-fourths of an inch wide, thus formed, attached on each side to the top of the scrotum. The point of the penis is then depressed and pushed under the bridge of skin. The scrotum will then be found to cover the penis like a hood. The bleeding should be quite stanched by the pressure of an iced sponge, or by the application of thin catgut ligatures. The folds of skin which were first formed for the deeper covering of the urethra, are then turned with the skin-surface downwards upon the urethral groove, and stitched together in the median line with a continuous or glover's suture of tolerably stout wire, which is to be cut off long at both ends, so as to be withdrawn easily when no longer required. Over the freshly-denuded surface thus presented, the scrotal bridge of skin is placed, raw surface to raw surface. The upper margin is then stitched by closely applied interrupted sutures both along the upper and lower borders of the bridge-flap.

A large sized india-rubber tube, well oiled, is to be placed in the groove of the urethra, passing well into the bladder. It can be held in place by wires, fastened on each side to the silver sutures applied to the scrotum. Finally the lines of sutures should be covered freely with collodion, and the urethra well oiled. The patient should be placed in bed, sitting bolt upright, with his knees placed close together, and quite flat upon the bed. A mackintosh should be arranged under him so as to catch the flow of urine, and drain it off to the side of the bed, where a dish can be placed to receive it. A mild opiate may contribute to keep the patient quiet. He should be fed on milk, eggs, and beef-tea with bread sops.

In all these plastic operations on the bladder and urethra, it is essential that the sutures should be left absolutely untouched until they are clearly useless. It will be found to be more convenient to take all away that have not dropped off, at one *coup*, with the patient under an anæsthetic. This prevents a great deal of crying and straining, which try very much the newly-formed adhesions. About a fortnight after the operation will usually be found the best time for doing this. The silver sutures do no harm, set up no irritation, and keep quite clean.

If the flaps get hot and swollen about two or three days after the operation, much benefit will be obtained by irrigation with boracic acid lotion—a semi-saturated solution. The cradle used to keep off the bed-clothes forms a convenient support for the irrigating vessel, and the fluid passes off by the mackintosh which conducts the urine away.

A modification of the operation just described has been found by the writer successful in a good number of cases of slighter conditions of *epispadias*. In many of these (as is usual), there was also incontinence of urine, from the groove in the urethra extending backwards into the prostatic portion, in the manner of a harelip, and preventing its grasp upon the neck of the bladder. This has been in many cases much improved by carrying the incisions well up to the prostate below the pubic symphysis (which is also frequently imperfect here). An india-rubber cap placed over and slightly constricting the penis and newly-formed prepuce, has, in some cases, been effective in retaining the urine for a considerable time, so as to keep the patient dry at night. In still slighter cases of *epispadias*, without incontinence of urine, the appearance of the penis has been improved by transplanting in the same way the redundant prepuce, which is nearly always found hanging below the penis like a dewlap.

By reversing this procedure, and placing under the penis the hoodlike termination of the prepuce, many cases of *hypospadias* —some of a severe kind—have, in the writer's practice, been much improved, and the urine conducted to the end of the penis, so as to render micturition more cleanly and comfortable. *See* Hypospadias.

John Wood.

ECTROPION, or Eversion of the Eyelids.—There are two forms, the acute and the chronic.

(1) Acute Ectropion is generally the result of the swelling and protrusion of the mucous lining of the lid in acute conjunctivitis. Occasionally, in children suffering from purulent ophthalmia, the upper lid may be completely everted. At first the lid may be easily replaced, but later, ulceration occurs in the crease of the skin, and this is followed by cicatrisation, so that the lid is permanently fixed in its everted state.

Treatment consists in relieving the conjunctivitis by appropriate remedies, such as nitrate of silver, and other astringent and antiseptic solutions.

(2) Chronic Ectropion may be due to disease or injury of the lids or adjacent textures, such as chronic conjunctivitis, chronic ciliary blepharitis, lupus, syphilitic and other forms of ulceration of the skin, and cicatrisation following wounds or burns of the lids, or caries of the orbit. Ectropion of the lower lid may result from paralysis of the orbicularis. One or both lids may be affected, and the eversion may be partial or complete. Besides the deformity, the patient suffers from overflow of the tears, consequent upon the displacement of the lacrymal puncta. If the eversion be of such a degree as to leave the cornea permanently uncovered, there is the superadded risk of inflammation of the conjunctiva and cornea, which may lead to intractable ulceration of the cornea. In chronic cases the exposed conjunctiva may become dry and semi-cuticular, or it may become thick, exuberant, and rough.

Treatment must be directed towards relieving the subjective symptoms and correcting the deformity. For the relief of the overflow of tears, one or other lacrymal canaliculus should be opened, and for the prevention or cure of conjunctivitis, or of ulceration of the cornea, mild astringent antiseptic lotions, as Lot. acidi boracici, gr. iij.–vj. ad f℥j., or Lot. quiniæ sulph. gr. ij.–iv. ad f℥j., should be gently used two or three times a day. In the intervals the lids should be protected by a light compress, smeared with boracic acid ointment (gr. x.–xx. ad ℥j.) In cases of eversion dependent upon, or associated with, hypertrophy of the conjunctiva, the exposed membrane should be gently touched once or twice a week with a stick of nitrate of silver, or a strip of the thickened conjunctiva may be excised. In eversion due to the formation of cicatricial bands in caries of the orbit, the adhesions may be freely divided subcutaneously with a tenotome. With a view to prevent recurrence of eversion after this, and the operative procedures to be enumerated below, it may be necessary to pare the edges of the lids and stitch them together, leaving them united till all risk of a recurrence of the eversion has passed. If the edge of the lid be elongated, and the skin fairly loose, the tarsal border may be shortened by the excision of a V-shaped piece, combined, if necessary, with a closure of the external canthus (tarsoraphia). In severe forms a plastic operation may be required (blepharoplasty), such as division and detachment of the cicatricial tissue which holds the lid back, or the introduction of a piece of new skin, either by a process of gliding, or interposition, or transposition of adjacent skin, or by transplantation of skin from more remote parts. For ectropion of the lower lid, due to paralysis of the orbicularis muscle, electricity should be used.

John Tweedy.

ECZEMA.—*Definition.*—Eczema is a simple, non-contagious inflammation of the skin, a characteristic feature of which is the formation of dry and red scaly patches, or, more commonly, of papules and vesicles or pustules, which break and leave excoriated surfaces, discharging a sticky, serous fluid, which dries into crusts and scabs. The disease is attended with more or less swelling and infiltration of the skin, and much itching.

Symptoms and Pathology.—The name 'eczema' is now used in a broader, though more exact, sense than formerly, and includes many conditions of the skin which were, until lately, regarded as distinct diseases, and classed respectively with erythema, lichen, pityriasis, or psoriasis, according to the degree of development or decadence of the eczema. The earlier writers of the present century held that a visible exudation or discharge was essential to constitute an eczema. More extended observation has led to the conclusion that this view is too restricted, and that the disease is often unattended with any visible exudation whatever. Eczema may consist of irritable red patches, or groups of scattered papules, or slightly raised and scaly spots, as well as of its more typical forms of vesicles or pustules with inflamed and excoriated surfaces; and any, or all, of these lesions may be present at one and the same time. This variable or polymorphic character of the disease is, indeed, one of its most distinctive and remarkable features. Eczema, as a rule, does not produce scars, and, as stated above, is non-contagious; nevertheless, *pustular eczema* is inoculable, and does occasionally, though very rarely, produce superficial scars.

Subjective sensations are always present in eczema, though they vary much in degree. Large excoriated surfaces give rise to severe smarting and burning pains, while the drier forms of the disease are often associated with intolerable itching, which is aggravated on exposing the skin to the air, and also at night. There is no part of the surface of the body which is exempt from attacks of this malady; it is, however, especially liable to appear on the flexor sides of the limbs and about the mucous orifices; in infants, the head is the part most commonly affected. Eczema attacks the skin for the most part symmetrically; it is, for example, rare to find one member suffer and the opposite member entirely escape. There are few exceptions to this rule, unless the inflammation is kept up on one side of the body by some purely local cause, such, for example, as varicose veins in the leg.

Etiology.—Eczema is by far the most common disease of the skin, and is met with at all periods of life from infancy to old age. It is rather more common in males than in females. The causes of eczema may, for convenience, be divided into (1) general or constitutional, and (2) local; of these causes the former are the more important. Most observers recognise the existence of what is called an hereditary tendency to this disease, but when we have to deal with a malady which is so common as eczema, it is not easy to arrive at an exact conclusion as to the degree of heredity; few families are entirely free. That some individuals have a strong tendency to attacks of eczema, and that others have no such tendency, is undoubtedly true, but the origin of this disposition or diathesis is often very obscure. The *exciting causes* of the disease vary somewhat with the age of the patient. In infancy there are three well-recognised and common causes—(1) the process of teething, (2) injudicious feeding, and (3) too frequent washing. In childhood especially, improper food plays an important part in the perpetuation, if not in the production, of eczema. Apart from an injudicious diet, a weak and imperfect digestion is a fertile source of chronic eczema in those who are predisposed to it. Constipation, and a general neglect of the action of the bowels, is another cause likely to perpetuate the malady. The most common exciting cause is, however, anxiety and mental worry, acting probably through the organs of digestion and assimilation. Among the less-defined exciting causes may be mentioned overwork, prolonged lactation, and the abuse of alcohol.

The best known local causes of eczema are (1) the application of irritating substances to the skin; this is met with in certain trades, such as those of barmen and bricklayers, where the hand is brought into frequent contact with irritating matter. Another example is seen in the effect of the aniline dyes on some sensitive skins. (2) Excessive sweating is very apt to produce an eruption of papular eczema on the chest and back; this is commonly observed in stokers, and is occasionally seen as the result of a Turkish bath. (3) Exposure to the sun, particularly in the tropics, is a well-known exciting cause of an eruption similar to eczema. (4) Excessive washing, especially with medicated soaps, is perhaps the commonest of all local exciting causes of the malady. (5) Mechanical irritation from rubbing and scratching plays a very important part in the extension, if not in the production, of eczema.

The diseases with which eczema is sometimes complicated or associated are chiefly gout and rheumatism, bronchial affections, and especially asthma, dyspepsia and catarrh of the stomach, boils, and varicose veins. Sometimes eczema alternates with attacks of gout, and at other times both are present at the same time; similar remarks apply with regard to asthma and stomach catarrh. Boils are often a troublesome complication, but usually yield to the kind of treatment which is suitable for the eczema, though in some instances they last for a long time after the latter is cured. The presence of sugar in the urine is very common in these cases.

Differential Diagnosis.—A typical case of eczema cannot be mistaken for any other disease. Acute eczema of the head, in which there is much swelling of the face and closure of the eyelids from infiltration, bears a very close superficial resemblance to erysipelas, and is often mistaken for it; in erysipelas, however, at the outset, the eruption is often one-sided, and the temperature is always relatively high; the pulse is quicker, and the tongue more furred than in acute eczema. Again, in erysipelas there is always loss of appetite, headache, and often wandering delirium at night. Acute eczema of other parts of the body is less likely to be mistaken for erysipelas. Dry, scaly spots of eczema, especially when they occur on the extensor sides of the limbs, are easily mistaken for poorly-developed spots of psoriasis; a previous history of eczema or psoriasis may aid the differential diagnosis in this case.

An acute or subacute attack of eczema of the palm often gives rise to the formation of blebs; this must not, of course, be confounded with pemphigus.

A dry and cracked eczema of the palm is often miscalled *psoriasis palmaris.* Strictly speaking, there is no such thing as psoriasis palmaris—that is, psoriasis which is limited to the palms; but eczema affecting the palms only is common enough, and from its dry and scaly appearance it is naturally mistaken for psoriasis; but sufferers from this malady, if they subsequently develop any eruption on other parts of the body, almost always develop eczema, and not psoriasis. Dry eczema of the palm may be distinguished from the well-known syphilitic eruption which it closely resembles (1) by the itching which is always present, (2) by the fact that it generally attacks both hands at the same time, (3) by the absence of any syphilitic eruption or symptoms in other parts of the body. For the differential diagnosis between eczema and 'the itch,' *see* Scabies.

The question is often asked of the surgeon, Is it always safe to cure eczema? In discussing this question it is admitted that an obstinate eczema sometimes disappears almost suddenly, and that coincidently with this disappearance of the eruption there may appear a catarrh (possibly an eczema) of the stomach, bowels, or bronchial tubes; it is reasonable, therefore, to ask—Is this so-called metastasis the result of treatment? We have the following reasons for believing that it is not:—(1) It sometimes happens in cases of eczema that are not under any treatment whatever. (2) It also occurs where the treatment has been of the simplest kind, and not altered perhaps for weeks before the metastasis occurs. (3) The same changes in the eczema often take place at the onset of well-defined febrile disease, such as measles, which could not be produced by any treatment, however heroic. (4) The disappearance of the eczema often distinctly follows (not precedes) the disturbance of the mucous membrane. Altogether, the cases in which the treatment has anything to do with the metastasis are so rare that they may be left out of practical consideration. But in cases of this kind, whether or not the cure of an eczema has caused internal catarrh, it is certainly both easy and wise to start the eczema again over a limited area by means of counter-irritants, and thus relieve the internal organs. Those who have had the largest experience in the treatment of eczema agree that they have more cause to regret the inefficiency of their remedies, than reason to fear their potency.

Acute Eczema.—*Treatment.*—The general treatment of acute eczema is simple and does not admit of much variation. In severe cases, where a large surface of skin is involved, the patient must be confined to the bed or couch; as the more acute symptoms pass away this rule may be relaxed. Free purging is always an essential part of the treatment, unless some exceptional circumstances contraindicate it. The best purgatives are sulphate of magnesia or sulphate of soda, or some of the natural mineral purgative waters in common use. When the attack is distinctly of gouty origin, the purgative treatment should be supplemented by the administration of alkalies, either with or without colchicum, according to circumstances. In the *local treatment* of acute eczema, ointments, especially those of a stimulating kind, must be strictly avoided. Usually the best and most soothing treatment is by water dressing, or a weak lead lotion may be used instead of water; but in no case must the dressing be allowed to get dry. During the daytime, when the dressing can be easily kept moist, it is usually better not to cover it with thin gutta-percha or oil-silk, but at night this plan may be adopted, in order to prevent the lint drying quickly. Some patients derive more comfort from linseed-meal poultices, which have the advantage of retaining the moisture longer than water dressing; otherwise the principle of treatment is the same in both cases. When the acute symptoms have a little subsided, the linimentum calcis may be used.

SUB-ACUTE OR CHRONIC ECZEMA.—The *general treatment* of sub-acute or chronic eczema is more or less common to all forms of the disease, and is independent of the particular region attacked; the *local treatment*, on the other hand, requires special adaptation to the stage of the inflammation in the part affected. In determining what form the general treatment should take in any particular case, it is necessary first to find out whether there is any other disease present which may tend to modify our treatment or guide it into the right channel. For example, when an attack of eczema is associated with gout or dyspepsia, the best plan of treatment is to cure the gout or dyspepsia, and treat the eczema by local means alone. In the great majority of cases, however, eczema exists as a malady *per se*, and is uncomplicated with other diseases. Under these circumstances, arsenic is by far the most valuable remedy, and this is especially the case when the patient is young. The best mode of administering arsenic in chronic eczema is, to give small doses with alkalies and some aromatic or bitter infusion just before or after each meal. Sometimes the mineral acids, combined with arsenic, are more beneficial than alkalies; no definite rule can be given on this point, but usually when the tongue is furred alkalies suit best. In children between the ages of one and three years one-drop doses of liquor arsenicalis three times a day are usually sufficient. The routine practice of treating eczema at this age with cod-liver oil and vinum ferri generally ends in failure, particularly when the eczema is of an irritable kind; in cases, however, where iron is especially indicated, the arsenic may be combined with the vinum ferri or the syrupus ferri phosphatis. In all forms of eczema great attention should be given to the proper action of the bowels; the malady is not infrequently associated with constipation, even in those who are not usually constipated, and unless this be overcome all other treatment will fail. The best form of purgative will vary with the circumstances of the case and with the age of the patient; in infancy, fluid magnesia in milk is one of the best; in childhood, sulphur powders in milk, or some effervescing saline purgative, are most suitable. In middle life, a morning draught, containing sulphate of magnesia or sulphate of soda, with some aromatic or tonic effusion, is usually the best form of purgative. Lastly, in old age, an aloetic pill at night is indicated.

Diet.—A well-regulated diet is of the first importance in the treatment of eczema. By a well-regulated diet is not necessarily meant a very abstemious diet; whether the diet should be abstemious or not will depend on the circumstances of the case. For example, pustular eczema in children generally requires a liberal meat and fish diet, with beer or wine; on the other hand, a dry, irritable, gouty eczema in the middle-aged is often benefited by a reduction in the usual amount of meat and stimulants. There are, however, certain kinds of food which are generally objectionable in eczema of all kinds and at all ages; these are coffee, sugar in all its forms, highly salted meat, and red pepper.

LOCAL FORMS OF ECZEMA.—*Eczema of the Scalp.*—In severe cases of eczema of the scalp, especially in children, the hair should be cut short and the head well oiled, and covered with a warm poultice for a few hours so as thoroughly to soften the scabs. The scalp should then be well fomented and cleaned with warm water. When all the crusts have been carefully removed, the head should be thoroughly dried, and when quite dry, dressed with an ointment consisting of acetate of lead gr. x., zinc ointment ʒij., calomel gr. xx., nitrate of mercury ointment gr. xx., vaseline ʒij., benzoated lard ℥ss.; or the white precipitate ointment diluted with an equal quantity of lard or vaseline may be used. When the eczema is of a very chronic, dry, and scaly kind, with no tendency to discharge, the best application is the red oxide of mercury ointment one part, vaseline or benzoated lard three parts. If the eczema of the scalp is subacute instead of chronic, and the head hot and irritable, a lotion should be used instead of an ointment; the head should be covered with lint soaked in lead or sulphate of zinc, or weak carbolic acid lotion (1 in 100). The lint should be kept in position by means of a thread or cotton nightcap; when the inflammation and discharge have subsided an ointment may be used.

Eczema of the Nostrils.—If any crusts are present, they should be removed by means of oil and warm water. Subsequently the diluted citrine ointment, made quite soft, should be carefully introduced with a small camel's-hair brush night and morning.

Eczema of the hairy parts of the Face. This is one of the most troublesome forms of eczema to deal with locally. All crusts should be carefully removed by means of oil and warm water, or a poultice may be used for an hour or two to soften them. In severe cases the hair must be cut short with a sharp pair of scissors, but never shaved. If the eczema is pustular, it is generally better, after the crusts have been removed, to dry it up as quickly as possible by painting the skin with a calamine and oxide of zinc lotion. The crusts, under this plan of treatment, form again quickly and must be again removed in a day or two by means of warm water as before; but, as the eczema improves, the crusts should be removed less frequently, especially when they are firmly attached to the skin. The hairs which pass through pustules should be pulled out; they come out easily and almost without pain, a little pus escaping. In dry forms of eczema of the hairy parts, the diluted citrine or red oxide of mercury ointment is usually the best local application.

Eczema of the Auditory Meatus.—Any crusts should be removed by syringing with warm water; this should be followed by using, two or three times a day, a tepid sulphate of zinc lotion (gr. iij.–vj. ad f℥j.), or a weak carbolic acid injection (1 in 100) may be used. In some instances the injection of a nitrate of silver lotion (gr. iij.–iv. ad f℥j.) is useful, or a rather stronger solution may be painted over the walls of the meatus by carefully inserting a camel's-hair brush. When the eczema is of a dry kind, or when all discharge has ceased, citrine ointment, diluted with four parts of oil or vaseline, is the best local remedy; it should be inserted with a small camel's-hair brush or dropped into the ear.

Eczema of the Scrotum, Labia, and Anus.—In dealing with subacute eczema in this region, the parts should be kept covered with lint well soaked in lead lotion. A pair of thin cotton bathing drawers will often be found useful in keeping the dressing in its place. As soon as the more acute symptoms have passed away, the parts may be dressed with either zinc ointment or with the compound lead ointment of the old London Pharmacopœia, made quite soft by the addition of more oil. The addition of a small quantity of tar or creosote ointment to either of these is very useful in dealing with chronic eczema about the anus. In *pruritus ani*, which is generally a form of undeveloped eczema, it is best to sponge the parts freely with a strong lead or boracic acid lotion, to which has been added two or three per cent. of the liquor carbonis detergens; the parts should then be dabbed dry with a handkerchief, and some ointment applied. In pruritus of the labia, painting with a solution of nitrate of silver (20–30 gr. to f℥j.) generally gives relief.

Eczema of the Legs.—The special indication in the treatment of chronic eczema of the legs is always to bandage them when this is possible; it has the double advantage of keeping the dressing in its proper place, and at the same time exercising a little pressure on the superficial vessels of the leg, which is very beneficial in most forms of eczema. Sometimes the solid india-rubber bandages are very useful, but they do not suit all cases.

Eczema of the Hands and Feet.—Chronic eczema of the hands, especially of the palms, is one of the most obstinate forms of the malady. This arises (1) from the natural thick condition of the cuticle, which becomes brittle and cracks with the movement of the parts, leaving troublesome fissures; (2) from the functions of the organ, which is never at rest and frequently washed, both which conditions are very unfavourable to the cure of eczema. Therefore the first rule is to rest the hand as much as possible, and to forbid all ordinary washing with soap and water. Soft gloves should be worn constantly during the day; this serves the double purpose of keeping the hands clean and the dressings closely applied. The lead ointments, or oleate of zinc ointment (ʒij. ad ℥j.), are very useful in the treatment of this form of the malady. In some very chronic cases, where the cuticle is much thickened, a saturated solution of salicylic acid in flexile collodion is an excellent dressing for removing the hard cuticle; subsequently, when this is thoroughly removed, the hand may be dressed with some oleate of zinc ointment in the usual way. India-rubber gloves and fingerstalls are sometimes useful in the treatment of chronic eczema of the hand. As a rule, eczema of the feet should be dealt with in the same way as eczema of the hands, but the toes should always be kept apart with small pieces of lint. Fissures both in the hands and feet are best treated by painting along the bottom of the fissure a solution of nitrate of silver with a very fine camel's-hair brush. In acute eczema of the hand, the arm must be placed in a sling and the hand dressed in the usual way with water dressing, followed by linimentum calcis.

Eczema of the Nipple.—Paget's disease of the nipple was, until lately, regarded as a form of obstinate or incurable eczema; it is now, however, generally believed to be a form of inflammation distinct from eczema. *See* NIPPLE, Diseases of the.

Washing in Eczema,—In the treatment of eczema, perhaps more mistakes are made with regard to washing than on any other point. In all cases of eczema, except those that are very chronic and psoriasis-like, ordinary washing with soap and water must be strictly forbidden; and, in the case of infants with general eczema of the body, all bathing must be discontinued. The new and delicate cuticle which forms over a healing eczematous surface is quickly macerated and destroyed by water, and thus the process of healing is indefinitely prolonged. ROBERT LIVEING.

ELBOW, Diagnosis of Injuries and Diseases of the. *See* ARM and FOREARM.

ELBOW, Excision of the. *See* JOINTS, Excision of.

ELBOW-JOINT, Amputation at the. Amputation at the elbow-joint is one not often selected by surgeons, although some operators of eminence, notably Professor Gross, have expressed themselves strongly in favour of it.

In performing the operation, difficulty may be avoided by bearing in mind the oblique direction of the articulation, such obliquity arising from the inner condyle being lower than the outer, the difference in level being nearly half an inch.

The operation may be performed by

I. The antero-posterior flap method (Dupuytren).

II. The single oval flap method (Baudens).

III. The circular method (Velpeau).

IV. Long anterior flap (Malgaigne).

V. Single lateral flap (Stimson).

VI. Double lateral flaps.

VII. Long single posterior flap (Holmes).

VIII. The rectangular method (Teale).

Of these methods the first and the third appear to the writer to possess the greatest merit. The former may be done either by transfixion or by cutting from without inwards. The anterior flap, at least two and a half or three inches in length, should have for its base a transverse line drawn three-quarters of an inch below the condyles. In making this flap the forearm should be flexed, so as to bring the articular surface of the humerus on a line with the edges of the coronoid process. Some operators make the base of the flap on a level with the condyles; but the advantage derived from making the base at the situation already indicated is, that the risk of subsequent projection of one or other of the condyles through the wound is diminished. The joint is then opened, the ligaments connecting the radius and ulna with the humerus being divided, and the triceps is then detached close to its insertion. The posterior flap is formed by passing the knife behind the olecranon and head of the radius, and cutting from within outwards; or the division of the structures forming the posterior flap may be effected by cutting from without inwards. The posterior flap in large muscular subjects may also be made by transfixion. Leaving the portion of the olecranon to which the triceps is attached was a method recommended by Dupuytren, with the view of minimising interference with that muscle. This can be effected with either bone-forceps or a small resection saw. Velpeau was opposed to this modification, but it has been warmly advocated by Gross, who also, to improve the shape of the stump, states that the 'inner trochlea' may be cut off on a line with the other surface.

In operating by the circular method, the incision should commence at least three inches below the condyles. This incision must not involve more than the skin, which should be dissected back half the length of the flap. The superficial muscles should be divided and retracted, and then the deeper ones. Next, the articulation—as in the previous operation—should be opened, and disarticulation effected. In this operation—in the writer's opinion the one to be preferred—the edges of the flap can be brought together, so that union may take place either in a horizontal direction, or from before backwards. The latter plan is usually adopted, as the cicatrix then falls between the condyles. Another plan, which has the alleged special merit of promoting facilities for drainage, consists in uniting the edges of the wound somewhat in the form of a leech-bite, a method the older surgeons used to advocate in other amputations.

The single and double lateral flap methods do not appear to possess any special advantage over those already mentioned. In operating by the first of these Stimson recommends the external flap, which should be four or five inches in length, to be 'made by transfixion from a point in the middle line, in front, a finger's breadth below the bend in the elbow; or from without inwards by an incision beginning at the same point and ending half an inch higher on the posterior face of the ulna. A second incision is made transversely across the inner side of the arm about an inch below the upper end of the first. The radio-humeral joint is opened, and the disarticulation completed.' Mr. T. Holmes has performed the operation by making a long skin flap from the back of the limb, a transverse incision dividing the anterior tissues, and the resulting stump was satisfactory.

The statistics of the operation when performed in cases of extensive injury, such as are produced by gunshot wounds, are not unfavourable. In the American war it was ascertained that there had been thirty-nine cases, with only three deaths, giving a mortality of 7·6 per cent.

William Stokes.

ELBOW-JOINT, Diseases of the.—This joint is frequently the seat of both acute and chronic inflammation; the acute being usually rheumatic, traumatic, or septic, the chronic most often being of scrofulous origin.

Acute synovitis of the elbow gives rise to pain, heat, swelling, and restricted mobility. The swelling is most manifest at the back of the joint, where it obscures the natural outline of the olecranon; pain is much increased by movement, especially in the direction of extension.

The first essential of *treatment* is to ensure rest to the joint, by fixing it to a splint, which is most comfortably applied on the inner aspect of the limb; the forearm should be flexed to rather less than a right angle, and in a position of semi-pronation. If the inflammation be very acute it is best to keep the patient in bed, and to place the arm on a pillow or swing it in a cradle; in less severe attacks the arm can be supported in a sling, and the patient allowed to be up. Leeches, cold, or other antiphlogistic remedies, can thus be easily applied.

Rheumatic inflammation in this, as in other joints, is very apt to lead to firm adhesions; and it must be remembered that the utility of the limb, should ankylosis occur from any cause, will depend greatly upon the position in which the joint becomes fixed, which should always, if possible, be at rather less than a right angle.

Chronic inflammation of the elbow-joint is attended with the usual thickening of the synovial membrane, which can be felt as an elastic swelling, filling out and obliterating the natural hollows of the joint. It is frequently of scrofulous origin, and then tends to progressive degeneration of the synovial membrane, destruction of the cartilages, and caries of the surface of the bones; or the disease may begin as an articular ostitis. When suppuration occurs, and matter makes its way to the surface, much inflammatory growth takes place in the tissues around and outside the joint, accompanied with corresponding wasting of the muscles.

Treatment.—In the earlier stages of simple chronic inflammation of the elbow, much good may be obtained from repeated small blisters, the actual cautery lightly applied, and the inunction of stimulant ointments. But when suppuration has occurred and the bone-ends are exposed and carious, as so often happens in the scrofulous cases, it is better as a rule to resort at once to excision; for the results of this operation are usually so satisfactory, and the utility of the limb so much greater than if ankylosis results, that it is justifiable at a much earlier stage of treatment than in the lower extremity.

Loose cartilages are occasionally met with in the elbow-joint, but are not usually productive of sufficient inconvenience to call for removal.

Osteo-arthritis also affects the elbow, giving rise to aching pain, impaired movement, crepitation in the joint, and alteration of the shape of the bones. Warmth, friction, the douche, and the internal administration of fatty foods do good in the earlier stages of the disease. Splints and apparatus of restraint should be avoided.

J. Warrington Haward.

ELBOW-JOINT, Dislocations of the. Dislocations of the elbow-joint, unlike other dislocations, are common in young persons, usually in boys between the ages of ten and fifteen, but are most frequent between the ages of fifteen and thirty-five. Displacements at the elbow include dislocations of the radius and ulna together, or of either bone separately. The former only will be described as dislocations proper of the elbow-joint.

The bones of the forearm, held together at their upper extremities by the orbicular ligament, may be dislocated in four principal directions—*backwards*, *forwards*, *outwards*, and *inwards*—the enumeration being given in the order of their relative frequency.

Dislocation backwards includes three varieties—(1) the dislocation *directly backwards*, which is by far the most common displacement at the elbow-joint; (2) *backwards and outwards*; and (3) *backwards and inwards*.

(1) *Dislocation directly backwards* is usually caused by falls on the palm (in boys often occasioned by leap-frog), and sometimes by blows on the back of the arm when the hand is fixed. The symptoms are fixation of the forearm at an angle of from 135° to 115°, and pronation of the hand. The forearm is shortened, and at the bend of the elbow is a rounded projection caused by the lower end of the humerus pressing forward the brachialis anticus and biceps muscles. Behind, the olecranon projects as a sharp angle, to the extremity of which the outline of the triceps may be traced, whilst on either side of this muscle there is a well-marked depression. The cup-shaped head of the radius may be seen and felt immediately behind the humerus on the outer side, and be made to rotate during pronation and supination. The amount of displacement backwards and upwards varies in different cases. According to Malgaigne, the most common dislocation is an incomplete one, the tip of the coronoid process lodging beneath the trochlear surface, the olecranon remaining about on a level with the condyles of the humerus, and the cup of the radius being only partly felt beneath the skin. This scarcely accords with general experience. In many cases—probably the majority—the coronoid process drops into the olecranon fossa, or at least lies behind the trochlear surface; and in a few this process has been found drawn up above the fossa, when dissected after death.

Some resemblance exists between the appearance of supra-condyloid fracture of the humerus and dislocation backwards at the elbow, but the distinctions between them are not difficult. In fracture the anterior prominence is angular and just above the bend of the elbow, so that the forearm is not shortened. The posterior projection is less angular and includes the condyles, to which the radial head and olecranon bear their normal relations. The movements of the joint can be obtained, though limited by pain. Crepitus is elicited on extension. Measurement between the external condyle and tip of the olecranon, which in dislocation is increased, in fracture is normal; and the distance between the external condyle and acromion, which in dislocation is normal, is shortened by fracture. Lastly, the deformity may be made to disappear under extension, but has a tendency to recur as soon as extension is relaxed.

Blood-effusion into the bursa over the extremity of the olecranon causes a projection at the back of the elbow not unlike dislocation backwards, and the writer has known this condition mistaken for dislocation, and force applied with a view of reducing it. The freedom of the movements of the elbow will serve to distinguish this accident from one of luxation of the joint.

The effect of dislocation backwards is to cause rupture of the anterior and lateral ligaments, laceration of some of the fibres of the brachialis anticus, together with a displacement forward of this muscle, the biceps, the brachial artery, and median nerve. In children, partial or complete separation of the epiphysis of the humerus may be a complication, and a very careful prognosis as to the future of the joint is in these cases necessary. Fracture of the coronoid process of the ulna is a complication occasionally met with, which may render the dislocation easy to reduce but difficult to retain in position. It was found associated with a vertical fracture of the head of the radius in a dislocation caused by a fall from a great height, the specimen of which is in the Museum of St. George's Hospital. The radius and ulna have been occasionally found dislocated backwards, but separated from each other.

Reduction of dislocation backwards is not often difficult. It may be effected in many cases by simply pressing the humerus back with one hand, whilst extension is made at the wrist by the other. Where more force is required pressure with the knee is usually employed. The patient sits in a chair, and the surgeon, resting his foot on the seat beside him, places his knee in the bend of the dislocated elbow; then, seizing the arm with one hand and the forearm with the other, he bends the joint across the front of his knee, and the bones slip into position. Some, with Guy de Chauliac, consider the pressure should be directed against the humerus, others follow Astley Cooper in pressing chiefly upon the bones of the forearm. The effect of force in the latter direction will be to draw the bones of the forearm below the humerus, and in the former to press the humerus back over the coronoid process. It is probably better that these two objects should be carried out simultaneously. A modification of the same method is to carry the arm round a post or through the back of a chair, and then make traction and flexion. In any case of difficulty the surgeon should employ an anæsthetic.

(2) *Dislocation backwards and outwards* is caused by the patient falling first on his palms, then on the inner side of his forearm, by which means the bones are carried first backwards, then outwards. The forearm is semiflexed, shortened, and usually strongly pronated, but in a case recorded by Velpeau it was said to be supinated. The coronoid process is lodged behind the capitellum, and the radial head projects behind and external to the outer condyle, there being a deep hollow above it, whilst the inner condyle is unduly prominent, and the olecranon projects boldly behind. A typical case observed and sketched by the writer occurred in a boy aged ten, who, when running at the game of ‘touch,’ was tripped up by one boy and fallen upon by another. The dislocation was easily reduced by extension and manipulation. It would seem reasonable to attempt to press the bones inwards before using traction to bring them forwards into place. In a case related by Debruyn, where forcible traction combined with flexion was tried on more than one occasion, the result was to convert the dislocation into one directly outwards, but no force would reduce it inwards. Amputation became necessary, and the brachialis anticus, biceps, artery and nerve were found behind the external condyle, the nerve and vessel having been ruptured by the attempts at reduction.

(3) *Dislocation backwards and inwards* is usually caused by a fall, in which the weight of the body is received first on the palm, then on the outer edge of the forearm or elbow, so that the bones are carried first backwards, then inwards. It has also been caused by a fall on the back of the wrist and forearm. The forearm is slightly flexed, shortened, and usually supinated. The external condyle is abnormally prominent, whilst the internal is obscured. The coronoid process is lodged at the back of the internal condyle, and the radial head rests behind the trochlea. The olecranon projects posteriorly, and is at a greater distance than normal from the external condyle. Astley Cooper, who first described this dislocation, reduced his case by forcible extension, when, he remarks, the brachialis anticus and biceps pressed the humerus back into position. It would appear advisable to press the ulna outwards before making extension, in order that the coronoid process may pass round the projecting margin of the trochlea before being drawn forward. However extension is made, it is probable the bones will tend to travel back along the same track by which they escaped.

DISLOCATION FORWARDS is rare, but rests on well-authenticated cases. It is caused by falls on the elbow when the forearm is flexed. The olecranon passes forward and lodges on the anterior surface of the trochlea, in consequence of which the forearm is lengthened to the extent of this process. The head of the radius can be felt anterior to its normal position, and there is a fossa between it and the humerus. The condyles of the humerus are more prominent than usual, and there is a depression between them where the olecranon should be lodged. Generally the forearm has been found flexed and supinated, but in one case extended. In a case of complete dislocation recorded by Monin, the bones of the forearm rose in front of the humerus, causing the upper arm to appear shortened. If the forearm be extended, the coronoid process and head of the radius distend the skin in front of the elbow. Reduction is to be accomplished by flexion of the forearm on the arm. In a case of difficulty an assistant should fix the hand whilst the forearm is flexed, and the surgeon, locking his hands on the upper part of the forearm in front, and resting his thumbs on the condyles of the humerus behind, should draw the bones of the forearm downwards and backwards, at the same time that he presses the humerus forwards with his thumbs.

DISLOCATION OUTWARDS is more frequent than dislocation inwards, owing to the latter being in a great measure prevented by the prominent inner margin of the trochlear surface. It is caused by a fall on the inner side of the forearm and elbow, or by a blow on the outer side of the humerus when the forearm is fixed. A case recently seen by the writer, in a man aged twenty-four, was caused simply by slipping off the curb and falling on the inner side of his elbow. The ulna is carried outwards, so that its greater sigmoid cavity rests between the outer margin of the trochlea and the capitellum, whilst the radial cup projects below and external to the outer condyle. The forearm is semiflexed, displaced outwards, and strongly pronated, whilst the inner condyle is abnormally prominent. The dislocation, as described, is complete only as regards the radius and as a luxation of the elbow-joint is *incomplete*, but very occasionally the ulna passes external to the capitellum, and the dislocation is then *complete*. Reduction is usually easy. The forearm should be seized at the wrist with one hand and supinated, by which means the pronator teres is made to draw the bones of the forearm towards the inner condyle; at the same time the elbow is grasped by the other hand in such a way that the fingers are used to draw the radius and ulna inwards, whilst the thumb presses the inner condyle outwards. Failing this, the knee may be applied over the inner condyle, whilst the forearm is supinated and drawn inwards.

DISLOCATION INWARDS is usually caused by a fall on the outer side of the elbow. The greater sigmoid cavity of the ulna embraces the under surface of the internal condyle, and the radial head lies against the inner margin of the trochlea. It is, therefore, incomplete. The forearm is slightly flexed, directed inwards, and pronated. The external condyle is unduly prominent and the internal obscured. To reduce this form of displacement the upper arm and hand should be fixed by assistants, and the surgeon should then draw the bones of the forearm outwards with one hand, whilst using the other to press the humerus inwards.

In a few cases the ulna has been found dislocated backwards, at the same time that the radius was dislocated forwards.

For the dislocations of the radius or ulna singly at the elbow *see* RADIUS; ULNA.

R. CLEMENT LUCAS.

ELECTROLYSIS.—The chemical decomposition produced by the passage of electricity may, under certain conditions, be applied to the treatment of disease. All forms of electricity cause electrolysis, and, although the voltaic current is at present the most convenient and effective, it is likely that other modes of developing and storing electricity may ultimately be preferred. The amount of decomposition is proportioned to the *intensity* of the current, that is, the quantity of electricity which passes through the electrolyte. The intensity is determined by the amount of electricity generated, and by the resistance offered to its passage. This resistance, inversely correlating the power of conduction, is composed of external and internal resistance, or that which lies in the electrolyte and conducting wires, and that which resides in the battery itself. Hence Ohm's law $I = \frac{E}{R_1 + R_2}$, in which I = intensity, E = electromotor force, R_1 = external, and R_2 = internal resistance. It is evident, therefore, that the work done will largely depend on the relative value of R_1 and R_2. If R_1 be relatively great, means must be taken to increase the penetrating power or tension of the current. This is done by multiplying the cells of a battery. On the other hand, R_2 is diminished by increasing the size of the cells. By reference to these facts we determine the form of battery to be used in the different applications of electricity in medicine and surgery.

In the process of decomposition by electricity there are two actions. One consists in the primary separation of the electrolyte into its components. These appear at the poles of the battery, that is, at the points where the conducting wires come in contact with the electrolyte. The substances which appear at the positive pole are called electro-negative ions, at the negative pole electro-positive. The same substance may vary in this respect according to its associations, but in a general way it may be said that oxygen, acids, and their allies appear at the positive, while hydrogen and bases appear at the negative pole.

The second action consists in the chemical changes which these nascent products bring about in their surroundings.

In organic electrolytes this secondary electrolysis is more important than the primary. Theoretically we should expect, and practically we find, that the effect of electrolysis on the tissues is mainly due to the chemical action of the nascent ions. With blood as the electrolyte, there is produced at the positive pole a tolerably firm dark coagulum adhering strongly to the electrode and of acid reaction; at the negative a pinkish white somewhat sticky froth, enclosing bubbles of hydrogen, while the remainder of the blood, according to the strength and duration of the current, assumes more or less the appearance and consistence of thin tar. On the solid textures a similar acid and alkaline reaction is produced, viz. at the positive pole a dry slough of small size with a contracting cicatrix, at the negative a livid, large, diffuse, soft eschar, the one resembling the effect of nitric acid, the other of caustic potash.

THERAPEUTIC USES.—Electrolysis has been employed for the cure of aneurism, for the destruction of tumours and other morbid products, and for the disintegration of urinary calculi.

Aneurism.—In aneurism our aim is to coagulate the blood in the sac. We may desire to accomplish this end at once, or we may think it better to produce only a small quantity of coagulum for the purpose of provoking the subsequent deposition of laminated fibrin. On this point there is divergence of opinion. Experience shows, however, that it is not more dangerous to attempt the full coagulation; and since deposition of fibrin subsequently is at least as likely after such an attempt, the bolder appears the better method. In most cases, however, it will be found impossible at once and permanently to occlude an aneurismal sac. It has been done, but the rule in successful cases is, that pulsation recurs for a time, even after its complete abolition. The froth occupies less space as the gas becomes absorbed, and the living current is again admitted in so far as the aneurismal wall may not have contracted with corresponding rapidity.

The constant current from a battery of considerable electromotor force should be used, that the work may be done in a reasonable time. Blood is a good conductor. The greatest amount of work, therefore, with the least shock and pain to the patient, is got from three to six cells of a size between those used for the cautery, where quantity is desired, and the ordinary medical batteries, where tension is necessary to overcome the resistance of the cuticle. As the effect is produced only at the point of contact, it is necessary to introduce needles into the blood. One needle should be connected with each pole. A larger number increases the risk of irritating the sac. Success has followed the insertion of one pole only, while the other has been applied to the skin; but with both poles inserted, the work done is more effective and accurate, and is painless. The needles should be insulated where they lie in contact with the tissues, to prevent pain, inflammation, and risk of hæmorrhage. Vulcanite was found many years ago by the writer and Dr. Fraser to be by far the most convenient insulator. The needles are usually made of steel; but to avoid destruction by acids, the one attached to the positive pole may be made of platinum or gold. The duration of the operation will be determined by the effect produced in diminished pulsation and increased tension through the formation of gas. From half an hour to an hour and a half is necessary.

If the operation be properly performed, it is free from risk. Inflammation of the sac is prevented by taking care that the exposed point of the needle does not touch it. Embolism has never occurred, and the hæmorrhage from the needle punctures is easily checked by gentle pressure, if the puncture be made where the wall is thick.

This operation has been most frequently used in aortic aneurism, after the failure of other treatment. In some cases, chiefly Italian, complete success has been attained; in others, marked amelioration. The writer has not been fortunate in obtaining a cure in aortic aneurism, but in several instances has averted for long periods impending death from external hæmorrhage, and has frequently produced diminution of size and amelioration of symptoms. On the other hand, in one or two instances he has thought that more rapid spread internally has followed the occlusion of the external sac by electrolysis.

In surgical aneurism it has been fairly successful, but it cannot be preferred to compression or ligature, and although safer in most cases than opening the sac, and in all than coagulant injections, such opportunities for its use do not frequently occur.

Blood-tumours.—In these forms of disease electrolysis finds its most complete success. It brings about a cure first by cauterising the tissues, and secondly by causing directly and indirectly coagulation of the blood. These products are then slowly absorbed. To get its best results it is absolutely necessary, by insulation of the needle and care in operating, to guard against the slightest cauterisation of the skin. Then the infinite division of the caustic prevents it from being carried into the circulation, its nascent form insures its energy, and its perfectly subcutaneous action avoids all possibility of inflammation or hæmorrhage, and all trace of scar.

For cirsoid aneurism it is the treatment *par excellence*. With perseverance and decision it will not fail. In aneurism by anastomosis it is less certain. It is difficult to occlude the huge caverns communicating with large veins and arteries so perfectly as to prevent the blood finding its way into them. It can be relied on only in examples of small size.

Whenever it is important to cure a nævus without a scar, electrolysis is absolutely certain and perfectly safe. The objection is that it is slow. Several operations are generally required, and it is of little use operating under intervals of six weeks. As much induration should be produced at a sitting as is possible without injuring the skin, or so overtaxing the absorbents as to lead to suppuration. With these precautions and perseverance, the effect is admirable in safety, precision, and absence of mark or scar. It is of course impossible by this or any other method to cure a simple port-wine stain without leaving traces of operation. It is to the subcutaneous and partly subcutaneous forms that the operation is applicable.

Goître.—The vascular kind of goître is amenable to electrolysis. The operation requires frequent repetition, but is probably as safe and effectual as any other form of local treatment. If the tumour be causing symptoms too dangerous to brook delay, electrolysis must give place to excision. It is not to be relied upon in the cystic and fibrous varieties.

It has been employed by Schuh and others in varix. It will cure, but is inferior to other plans of treatment.

Solid Tumours.—The use of electrolysis proposed by Beard and Rockwell for the open as distinguished from the subcutaneous removal of abnormal growths, presents no advantage whatever over other methods by knife, cautery, or caustic. Consequently, after several trials, the writer has abandoned its use for malignant tumours, even when they are highly vascular. On an average the increased growth produced by irritation outweighs the absorption of the part destroyed. Doubtless electrolysis is capable of procuring the disappearance of many simple tumours, but in most it is less certain, far more tedious, and, from the necessity of anæsthetics on each occasion, not more safe than the knife. In some chronic hypertrophies and inflammations, however, it may often be useful. If pus have not already formed, and there be no persistent local cause, enlargement of lymphatic glands may be treated by electrolysis perhaps as hopefully as by any other local application. Success has followed the use of electrolysis in hydatid and other cysts.

John Duncan.

ELEPHANTIASIS ARABUM.

—*Definition.*—A chronic hypertrophy of the skin and subcutaneous tissue, occasioning enormous enlargement and deformity, the result of repeated attacks of inflammation of the lymphatics and skin.

The term ‘elephantiasis’ is generically applicable to any hypertrophy of the skin, to whatever cause it may be due, whether to varicose veins, chronic eczema, ulcers, lupus, or syphilis; or to any condition producing compression of the veins and lymphatics, such as exostosis, enlarged glands, bone-disease, or old-standing dislocation. It is equally applicable to any hypertrophically enlarged limb, though it be merely a congenital deformity. But although any of these local causes can produce elephantiasis—the hypertrophic condition of connective tissue and morbid anatomical appearances of which are identical with those observable in the disease under consideration—elephantiasis arabum signifies far more, and differs altogether from simple hypertrophy as seen in this country, while at the same time it must not be confounded either with elephantiasis græcorum, which is true leprosy, or with elephantiasis italica, another name for pellagra.

Elephantiasis arabum is dependent on a variety of climatic conditions, and is endemic in tropical countries, chiefly in India, China, Egypt, Arabia, Barbadoes, and other islands of the West Indies, and in South America. Some authorities believe that it is commonest near the sea-coast, others that it occurs in damp and humid regions, while others again hold that it is to be found most frequently in a malarious district. It is said to affect males rather than females, the poorer and ill-fed classes rather than those who, well-clothed and nourished, obey the ordinary hygienic laws of life. It is considered that the variety of elephantiasis arabum known as lymph scrotum most frequently attacks the natives who habitually wash in stagnant, dirty water, and that the legs are affected in those who walk barefooted. No race of men is entirely exempt from this disease, which is, however, far more common among the dark than the fair races, and but seldom attacks pure Europeans.

Course and Symptoms.—The disease is usually ushered in with fever—aptly called ‘elephantoid’—resembling ordinary intermittent fever, in the regularity of its recurrence, sometimes at monthly intervals, but differing from it in its duration. Inflammation of the lymphatics, either preceding the fever or appearing at the same time, produces general swelling of the part attacked. The skin becomes red, tense, tender, and burning, often vesicles or bullæ are formed, which discharge a serous or chyle-like fluid, the attack presenting, as a whole, all the characteristics of an attack of erysipelas. The general constitutional symptoms accompanying the fever are, as a rule, headache, malaise, nausea or vomiting, and severe lumbar pains, with the addition of dragging and tenderness in the groins and spermatic cords when the scrotum is the seat of mischief. After awhile, both the fever and the local inflammatory symptoms disappear, and the patient is, for the time being, restored to health. At the end of this interval of rest the fever returns, together with a renewed erysipelatous attack of greater severity, the lymphatics becoming more involved, swollen, and twisted. Again the acute symptoms abate, but the affected part, though free from heat and pain, remains swollen and distorted. The meshes of the corium and subcutaneous tissue are distended with lymph, from which the connective-tissue elements draw excessive nourishment and become hypertrophied. The condition of the part after the first few attacks is like œdema from dropsy, causing pitting on pressure with the finger; but after several attacks of fever and local inflammation, the part feels dense and hard, and even much force will not produce the slightest indentation. After some years—Mr. V. Richards says as many as eleven and a-half—the attacks of fever cease, and the part becomes uniformly and permanently swollen. If the region affected be the leg, the appearance produced is one of monstrous deformity. For, although the enlargement rarely occurs above the knee, and there is always a constriction around the ankle, the foot and leg become one shapeless mass, like an elephant's leg, hence the name of the disease. The outline of the ankle is obliterated, no bones can be felt, and the toes are entirely hidden.

The severity of the constitutional symptoms varies; in some cases there is little or no rise of temperature, while in others the fever is intense. The pain also varies, being sometimes comparatively slight, in other instances so severe during the inflammatory attack as to prevent the patient walking. Itching is occasionally a great additional torture.

The appearance of the skin in the hypertrophic stage differs considerably in individual cases, and also in different parts of the same limb, At times, and in certain parts, it is hard, dark, and scaly, or again it may be smooth and tense, in which condition it is often attacked with eczema; or, yet again, it may be rough and tubercular. Another variety presents an appearance resembling ichthyosis, the epidermis being thickened and dirty-looking. Lymph may exude upon the skin from vesicles or small soft swellings, or the surface may be warty, or broken up by deep, foul, discharging ulcers.

Elephantiasis scroti generally commences, according to Pruner, in the form of a hard kernel under the skin, usually at the bottom of the left side of the scrotum, and is attended with severe fever and constitutional disturbance, similar to that already described. The skin becomes thickened, indurated, furrowed, and wrinkled. The abdomen alters in form, the skin being drawn down so as to assist in enlarging the scrotum. The penis also increases in size, but becomes hidden in the enormous overgrowth beneath it. As the tumour enlarges, which it may do to the size of 100 lbs. or more, the lymphatics become varicose and often burst, the discharge from them drying and forming crusts. A condition called 'lymph varix,' described by authors under various names, is said to occur chiefly in China, and is most often associated with elephantiasis scroti. It presents the appearance of a soft tumour which, when punctured, exudes a pinkish or whitish fluid like chyle.

The parts most commonly attacked by elephantiasis arabum are the leg, usually one only, and the external genital organs, male and female. It also assails the arms, scalp, ears, and tongue, showing a preference for the parts in the order named.

Morbid Anatomy and Pathology.—To the naked eye a section through a limb affected with elephantiasis arabum presents an appearance of layers of enormous thickening in the corium, subcutaneous tissue, fasciæ, and periosteum; and, while the bones are hypertrophied, the muscles are wasted from long-continued pressure. There is much exudation of lymph, and to the touch the section is tough and unyielding.

Under the microscope the horny layers of the epidermis are seen to be in some places thickened and rugose, in others they are hardly more than normal. The connective tissue of the corium has a swollen gelatinous appearance. The subcutaneous tissue is in one part dense and fibrous, in another soft and jelly-like. The lymphatic vessels are much dilated, and contain lymphatic cells in fibrin (Cornil). In one of Sir Joseph Fayrer's cases of elephantiasis scroti, Mr. D'Arcy Power found the outer layers of the epidermis but slightly thickened, the rete malpighii remarkably so. The subcutaneous tissue was very greatly thickened and contained a large amount of unstriped muscular tissue. The blood-vessels were very numerous and of large size, the lymphatic channels fairly numerous, and some of them of considerable diameter. In another case there was a large amount of lymphoid tissue, and in the subcutaneous tissue small highly refracting angular bodies, staining deeply, supposed to be filariæ.

Simple hypertrophy of connective tissue is the result of over-nutrition of the parts, arising from inflammatory or mechanical occlusion of the lymphatics. Some authorities maintain that though there is a local inflammation, the result of lymphatitis, the disease itself is due to some special dyscrasy, which is probably more or less induced by undue exposure to great alternations of temperature in humid and hot climates. Others trace it to exposure, whereby the part is brought into direct contact with some poison which penetrates the skin. Some have attributed it to malaria also, and others again believe that the whole pathology is to be explained by the fact that a minute animal known as the *filaria sanguinis hominis*, blocks the lymphatics and sets up the inflammation. The theory of the relations between the filaria and elephantiasis arabum is both ingenious and interesting. As long ago as 1866 Wucherer, of Brazil, detected the embryos of a special entozoon in the urine of a patient suffering from chyluria. Unaware of this discovery, Lewis, of Calcutta, in 1868, called attention to his own observations of a like kind, and in 1872 announced that he had found filariæ in the blood of a person suffering from elephantiasis arabum, and gave them the name of filaria sanguinis hominis, and claimed to have found in them the cause of the disease. In 1875 Patrick Manson advanced the opinion that the inflammation caused by the presence of the adult filariæ in the blood produced obliteration of the lymphatic trunks—perhaps even of the thoracic duct—and, arresting the lymph-current, consequent hypertrophy. In 1877, a still further step was made. Some eminent authorities, among them Bancroft and Spencer Cobbold, came to the conclusion that there was evidence that elephantiasis arabum was propagated by the mosquito, and, rightly or wrongly, this is now the generally accepted theory, and it certainly seems to harmonise with many of the facts. It was found that the filariæ reposed in some organ of the patient during the day, and appeared in the blood only at night, which is the time when the mosquito feeds. It was further known that, after laying its eggs, this insect makes its way to the water and there dies, and so liberates the filariæ. Bathing in water thus contaminated, the natives expose the legs and genitals to contact with the filariæ, which either effect an entrance through the skin, or are swallowed in drinking the water. According to the most recent opinion, the female filariæ live in the lymphatics, but beyond the glands, lay their eggs which are carried with the lymph to the ganglia, where being too large to pass, they are hatched, and as embryos follow the lymphatics, and so find their way into the blood. Facts, however, seem to show that elephantiasis arabum may exist without the presence of filariæ, and *vice versâ*, so that we can hardly feel full confidence in the theory without some more satisfactory evidence. *See* Filaria Sanguinis Hominis.

Treatment.—1. Inflammatory stage.—Rest in bed, with the part raised, if it be the leg or scrotum. Salines and aperients at first, to be followed with quinine or arsenic in full doses, to mitigate the severity of the fever, and opium to relieve pain. Poultices, either hot or cold, should be applied locally.

2. Of resulting enlargement and constitutional condition.

a. Local. — Some authorities advise blistering the enlarged inguinal glands, rubbing iodine ointment into the swollen leg and bandaging it evenly and firmly, while using constitutional treatment. Blistering is said to be of particular value directly the inflammation has subsided. Others prescribe cataplasms and tepid baths or oils to soften and remove the epidermis and crusts, followed by inunctions of mercurial ointment and careful bandaging, to be repeated when the bandage gets loose. The limb to be kept horizontal.

Elastic Bandage.—The use of Martin's elastic bandage has been followed by the greatest success in the prevention of the hypertrophy. It should be applied firmly from the foot upwards immediately after the inflammatory symptoms have subsided, and should be worn for months.

Electricity. — Though not infallible, there is little doubt that electricity is one of the best forms of treatment at present known. A galvanic current of 40 to 60 Trouvé elements, applied from five to thirty minutes, with the *positive* pole on or near the sound part, and *negative* pole on different parts of the affected regions, has been tried with success. Either or both forms of electricity may be used at the same sitting.

Compression of the Main Artery.—The results obtained from digital compression have been satisfactory.

Ligature of the Main Artery.—The best authorities disapprove of this mode of treatment, which is held to be but temporarily ameliorative. In one case, however, cure was effected by this means in six months.

Amputation of the Leg.—This has occasionally to be resorted to, in consequence of the enormous size.

Removal of the Scrotal Tumour.—The spermatic cord, testicles, and penis are dissected out, and no attempt should be made to preserve flaps of integument either for penis or testicles, as it is found unnecessary and seems to be followed by recurrence. Healing is effected in from two to four months. At times removal of the whole tumour, testicles and penis included, has to be performed, but when possible the genitals are preserved, not only to avoid mutilation, but also from fear of sudden and extensive hæmorrhage, and contraction of the urethra. By careful bandaging the operation may be made almost bloodless. *See* SCROTAL ELEPHANTIASIS.

b. Constitutional Treatment.—Quinine and arsenic, or quinine and iron, or iodide of potassium, give the best results, but drugs have but little power either to prevent recurrence of the disease or to check its progress. Change of climate is the most potent remedy, often arresting an attack in its early stages. Europeans should return to Europe and natives remove to a drier district.

MALCOLM MORRIS.

ELEPHANTIASIS GRÆCORUM.—*Synon.* Leprosy, Lepra.—*Definition.*—An endemic, chronic, constitutional disease, analogous to syphilis, varying in its morbid manifestations, according to whether the brunt of the disease falls on the skin, nerves, or other tissues.

Etiology.—This must be considered as regards its production and propagation. Concerning production, neither climate, soil, race, malaria, diet, bad hygiene, nor antecedent diseases, such as syphilis, yaws, or ague, can be regarded as anything more than predisposing influences which favour its onset and development, mainly by lowering general vitality and, therefore, resistance to disease. As regards climate, while it is certainly most prevalent in tropical and sub-tropical countries, it frequently occurs also in cold climates, such as Norway, Iceland, and New Brunswick; in short, it may be found from the poles to the equator, from the east to the west. As for soil, it may occur in high or marshy lands, in town or country, by rivers and seas; and though it is true, in the main, that the home of leprosy is in the vicinity of water, even this must not be said without reservation. Climate seems, however, to have an influence on the form of the disease, as tuberculated leprosy is most common in Europe, probably from the influence of cold checking the action of the skin, and non-tuberculated in warmer climates. Eating fish, especially if putrid, is supported by some high authorities as the cause of leprosy, the idea having, probably, arisen from fish being a staple article of diet in tropical and subtropical countries where leprosy is endemic; but since in many countries leprosy is rife where (either from religious prejudices or other circumstances) no fish is eaten, this theory must be regarded as untenable.

Propagation.—Intermarriage plays a certain part, and in some places, such as the Cape, Provence, Asturia, and Galicia, leprosy is limited to certain families who intermarry.

Heredity has an undoubted influence, and Norwegian authorities consider that it may be transmitted collaterally as well as directly, and that it may even skip a generation, the second and fourth being worse than the first and third. The mixed form is the kind most frequently transmitted, and often only one member of a family is attacked; the disease may, however, be latent many years, until developed by some depressing influence, and congenital cases are very rare; for these reasons many think that, like phthisis, only the predisposition is transmitted. The question whether leprosy is contagious or not, is answered, by the College of Physicians' Report, in the negative; but there is much evidence in favour of its being inoculable even by vaccination, while coitus, prolonged contact, and even breathing the same atmosphere for a long period, seem to have produced it in some instances. The invariable presence of bacilli in the tissues of the tuberculated form, and the fact that the prevalence of leprosy in Norway has been diminished fifty per cent. in twenty years by strict segregation, are circumstances which are also in favour of the contagious theory.

VARIETIES.—The disease presents itself under three aspects: the tuberculated, the non-tuberculated, and the mixed tuberculated lepra. Tuberculated lepra is the most common in Europe, non-tuberculated in the tropics, and mixed tuberculated is always less common than either of the others. Although one pathologically, they are clinically so distinct as to require separate description.

Tuberculated Lepra.—Five stages may be recognised: (1) deposit with prodromata and fever, (2) eruption, (3) tuberculation, (4) anæsthesia (not always), (5) ulceration.

The prodromata which are nearly always present are: debility, depression, dyspepsia, diarrhœa, and drowsiness, a frequent sense of chilliness, profuse perspirations, with marked greasiness of skin, especially in the dark races; frequent vertigo, and recurrent epistaxis which temporarily relieves the vertigo. After a variable time, and, in some cases, without the prodromata, the febrile symptoms set in with a rigor and a rise of temperature, sometimes reaching 104° F., the pyrexia is nearly always of a remittent type, and with the sweatings, simulates ague; but the drowsiness is now very marked, and is very significant in a leprous district; the tongue is red, the pupils sluggish, and the pulse quick and feeble. Then, after a variable period, the exanthem, or 'leprous spots,' appears, coming first with œdema of the eyelids, on the prominent parts of the face, and then on the limbs; it is erythematous in appearance, but attended with deposit from the beginning; it is slightly raised, defined at the edge, from one to several inches in diameter, and distinctly hyperæsthetic at first; in colour it is purplish or mahogany red in fair people, but of a brighter red and shining in the dark races. The spots may come and go for weeks and months, each time with febrile symptoms, and then tuberculation sets in, as a rule, six months from the onset of the disease.

The tubercles come out in crops in the same places as the erythematous eruption, which by this time has faded; they vary from a pea up to a hen's egg in size, and may coalesce into an infiltration, diffuse or in clear-centred circles, or the infiltration may arise directly from the erythema which gradually thickens into this condition, without the intervention of the tubercles. The colour of the infiltration and of the tubercles is from a yellowish to a dark brown in fair, and blacker than the black skin in the dark races. As the tubercles and infiltrations develope, the hyperæsthesia gives way to diminished sensibility or even anæsthesia, which, in this form, is limited to the sites of the eruption, and is due to the pressure of the leprous infiltration on the ends of the nerves.

While tubercles may come anywhere except on the scalp and glans penis, the face, limbs, breasts, scrotum, and penis being the usual sites, the mucous membranes do not escape, and, when tubercles involve the air-passages, they often endanger life.

Ultimately, the tubercles either resolve, leaving stains, or atrophy, leaving scars, or they may break down and form indolent, sharply-defined, red glazed ulcers, with yellow, glairy discharge of a peculiar odour. At first, these ulcers can be healed by appropriate treatment, but as the disease advances they extend, and may involve almost the whole body. When the disease is fully developed, the face gets the characteristic leonine appearance, from the thickening of the skin over the brows between the natural wrinkles, the cheeks look full and pendulous, the lips are swollen and everted, and, with the nose and chin, are covered with tubercles; the ears project, and, even at an early stage, are often much thickened and covered with tubercles, and the lobe is specially enlarged, soft and pendulous. The hair of the scalp is preserved, but is lost elsewhere, and the nails also go or are represented by horny pegs. In the male the testes atrophy and the breasts enlarge; women become sterile, the voice is reduced to a croak, from the tubercles in the larynx, they snuffle from the thickened nasal mucous membrane, and blindness may ensue, from corneal tubercles or keratitis.

At varying intervals—often at the change of the seasons—exacerbations, with fever, occur, with enlargement of the lymphatic glands—especially the femoral—and after each one fresh tubercles appear, and so each attack is a milestone on the downward course.

Ulceration eventually sets in, slowly as a rule, but sometimes phagedænic, and from its extent exhausts the patient, or he may die from interference with the air-passages, extensive internal deposits, or from renal and lung complications, and less frequently from diarrhœa, anæmia, &c. In hereditary cases, before the disease developes, it may be noticed that ordinary sores are indolent and unhealthy, the lymphatic glands are enlarged, the aspect is cachectic, the features coarse and the head large, and the patient is deficient in vigour, both mental and bodily.

The special symptoms in such cases generally come out between the ages of ten and twenty, rarely under three years, and only one or two instances of its being congenital are known.

Non-tuberculated Lepra is the most common tropical form, constituting two-thirds of all the cases. Three stages may be recognised: (1) development, (2) spreading, (3) permanency.

The first lasts one or two years, and includes the prodromata, the eruption and the commencement of atrophy; there are no febrile symptoms with the prodromata, but frequent chilliness is experienced, with malaise and other ill-defined symptoms, but the most characteristic are pain and tenderness in various places, general hyperæsthesia of the skin, and shooting pains down certain nerves, especially the ulnar, the median, and peroneal, accompanied by a burning sensation and tenderness along the course of the nerves; frequently an eruption of small bullæ occurs on the extremities where the nerves are affected, and sometimes 'glossy skin' is developed. Weakness of grasp and numbness in the course of the nerves are early symptoms, and the ulnar is generally the first to suffer.

Within a year the more special eruption breaks out, the most frequent positions for it being the back, shoulders, back of the arms, thighs, round the knees, the elbows, on the face, and sometimes in the course of nerves, especially the musculo-spiral. The spots or patches come out singly as a rule, are one or two inches in diameter, well-defined but not raised, of a pale yellow in fair, but bright yellow in dark races; they may itch or burn, but are not hyperæsthetic and rarely anæsthetic at this stage, but the sweat secretion is absent in them. From time to time fresh patches come out, but unattended by special symptoms; sometimes some of the muscles waste, and there is contraction of the little finger, while sensation in the course of the affected nerve is gone by this time, if it has not before, and the second stage supervenes.

This stage is marked by the spreading of all the patches, except those on the neck, at their periphery, forming irregular circles, ovals, or gyrate figures; the border is now distinctly raised, a quarter or half an inch broad, of a yellowish-brown colour, highly sensitive at the spreading edge, which may be papular or vesicular, the centre is atrophic, preternaturally white, or yellow in dark people, thin, wrinkled, hairless, scar-like, and dry, often covered with a powdery desquamation, and always more or less anæsthetic. The anæsthesia in the course of certain nerves also is always slowly extending its area, and the patient frequently suffers from burns and other unconscious injuries in consequence, while perforating ulcer of the foot is very apt to occur in those who walk barefoot. In cold weather solitary large bullæ very often come on the anæsthetic extremities, leaving an indolent ulcer. Paralysis is usually a late symptom, and is accompanied by wasting of muscles and flexion of the fingers, giving a claw-like aspect to the hand, which drops helplessly at the wrist. Next, interstitial absorption of the phalanges ensues, leaving the nail still attached to the stump, or a larger necrosis may occur; but on the whole, with the exception of sleeplessness, the general health continues good, and often improves when the third or permanent stage is reached, which is in about ten years from the commencement. From henceforth the eruption remains stationary, though by this time nearly the whole body-surface may have been traversed by it, so that the whole skin is atrophied, and white or yellow according to the race. Other nerves, such as the third and seventh, or some nerve of the leg may get paralysed; ulcerations are common, and, though less extensive, are deeper than in tuberculated cases; moist or dry gangrene often occurs, and, spreading until it reaches a joint, a line of demarcation is produced, and a natural amputation is performed. Although the same process is often repeated, it is slow and not extensive each time; the strength is, on the whole, wonderfully preserved, and, unlike the other form, sexual power is retained up to a late period.

Ultimately, however, the ulceration, gangrene, marasmus, and general debility from the leprous poison produce the inevitably fatal result, about two-fifths of the cases thus dying directly from leprosy; muco-enteritis is the immediate cause of death in nearly as many more, and the rest reach their end through various complications, but nephritis is not especially frequent, as in tuberculated lepra.

Mixed tuberculated lepra is the least common form, constituting about one-sixth of all cases, about half are hereditary, and often each parent has had a different form.

It begins sometimes with tuberculated and sometimes with non-tuberculated symptoms, but most frequently the non-tuberculated symptoms take the lead for a few months, and then with fever and the usual phenomena tuberculation occurs. Destruction of the cartilages of the nose sometimes ensues, and the soft palate may also be destroyed by ulceration, and these incidents constitute special features of this form. For the rest the symptoms are a compound of the other two varieties.

The prognosis is bad, and if the tuberculated precedes the non-tuberculated form the progress is more rapid. The diagnosis requires care sometimes, to distinguish leprosy from syphilis, but the presence of anæsthesia would be a certain criterion.

Pathology.—Modern research is strongly in favour of the disease being one of constitutional origin, closely analogous to syphilis, in which special bacilli, either directly or indirectly, by their presence set up inflammatory changes in the tissues, to which many of the lesions are due; they also specially modify by their presence the exudation cells, and the endothelium of the lymphatic and blood vessels forming the so-called 'lepra cells' and giant cells, which impart specific characters to new growths which would otherwise not differ from ordinary granulation tissue, except that the infiltration is in foci instead of being diffused, and is poorly supplied with vessels.

Morbid Anatomy.—The essential features are infiltration of the skin or mucous membranes by foci of small round cells, which are especially abundant round the vessels, and where these are most numerous, viz. round the follicles and glands; interspersed in this infiltration are larger cells called 'lepra cells,' of which there are all gradations, from those little larger than a leucocyte up to the multi-nucleated giant cells. It is in these lepra cells that the bacilli are placed, and the large cells are most abundant in the deeper and peripheral part of a tubercle; there is every reason to believe that the lepra cells grow from the leucocytes or connective-tissue cells under the irritative or stimulating influence of the bacilli, one or more of which may often be seen in a leucocyte-like cell, and many in the lepra cells. The giant cells appear to be derived from the endothelium of the blood-vessels or lymphatics, and also contain bacilli in abundance.

These bacilli can best be brought into view by staining the section or fluid containing them by the Weigert-Ehrlich process for tubercle bacilli; but they require a higher power, a tenth or twelfth immersion, to see them satisfactorily, as they are much smaller than tubercle bacilli. For clinical purposes the fluid from the débris of a broken-down tubercle, or the serum obtained by squeezing a tubercle in a clamp, as Manson recommends, and then pricking the blanched tubercle, should be dried on a cover-glass and stained by the above-mentioned process; the bacilli then appear as red, straight rods, not larger than half or three-quarters of the diameter of a red corpuscle, contrasting with the blue ground. That they are really morbific agents is evidenced by their invariable presence in every case of tuberculated lepra examined, no matter whence it may have come; by their presence coinciding with the development of the lepra cells; and, though inoculation has failed to produce the general disease, a localized leprosy has been produced in dogs.

In non-tuberculated lepra foci of cells are infiltrated between the fibres of the nerve, penetrating from without inwards, until ultimately most of the nerve-fibres become pressed upon individually as well as collectively, but inasmuch as the infiltration is in foci some fibres escape, and this accounts for the oases of sensibility in anæsthetic areas. Bacilli have not hitherto been demonstrated in this form of lepra. Besides these lesions in the skin, mucous membranes, and nerves, tubercles may be found in the pleuræ, but no specific leprous changes have been found in the lungs, liver, spleen, or kidneys, nor even in the enlarged lymphatic glands which are mainly fibroid. The testes, like the sebaceous and sweat glands, atrophy by pressure of the small cell infiltration between the tubules or acini of the glands. Although there is nothing specific in the lardaceous infiltration of the liver, spleen, and kidneys, it is a frequent sequel to the prolonged ulceration, and fatty kidneys are also rather common in the tuberculated cases.

Prognosis.—Almost invariably bad; but existence, though too often in a very miserable state, may be prolonged for many years. The form of the disease exercises a most important influence, the tuberculated averaging seven or eight years, the mixed ten, and the non-tuberculated fifteen years. In all cases heredity, youth, and mental depression have a bad influence on the course of the disease.

In tuberculated cases, unfavourable elements are frequent febrile exacerbations, the extensive implication of the air-passages or internal organs, and the supervention of lardaceous disease from prolonged suppuration; whilst, if the patient comes early under treatment, if the exacerbations occur only at long intervals, if the infiltration is diffuse rather than tubercular, and his general surroundings are good, considerable amelioration of his condition and arrest of the disease for some time may be hoped for. In non-tuberculated lepra the extent of the nerve-implication is a good guide; arrest of the progress of the disease may be produced when this is limited, if there are no serious complications and the patient is seen at an early stage.

In mixed lepra the accidents of both occur, but it is usually intermediate to the other two in duration.

Treatment.—This, unfortunately, can only be palliative or preventive, the number of so-called specifics bearing testimony to the incurability of the disease. Of the many recommended, only two have stood the test of long experience—namely, Chaulmoogra oil, from Gynocardia odorata, and Gurjun oil, from Dipterocarpus lævis. These oils are taken internally, and rubbed in externally. Both are very nauseous, and are best given in emulsion or pearls, beginning with small doses. The Chaulmoogra oil should be begun in doses of three minims, or one pearl, three times a day, after meals, and gradually increased up to the limit of the patient's endurance. Seldom more than a drachm a day can be tolerated, nausea, vomiting, and diarrhœa ensuing if the dose is too great for the individual. Gynocardic acid, in pills, has also been recommended, in doses beginning at half a grain and gradually increasing it up to three grains three times a day. The oil also should be well rubbed in, in the form of an ointment consisting of equal parts of the oil and lard; the friction should be thorough and prolonged, where possible for two hours twice a day, rubbing off the old oil with fuller's earth, or a warm bath may be given.

When Gurjun oil is employed—and it is spoken of most highly by practitioners in the tropics—it is given internally in an emulsion consisting of lime-water three parts and Gurjun oil one part, half an ounce being given twice a day; at the same time a liniment of equal parts of the oil and lime-water is rubbed in, in the same way as the Chaulmoogra oil. The writer finds that in this climate the emulsion cannot be made by this formula, the oil being too solid. For the mixture it is found best to rub it up with powdered gum arabic and water, but English patients could not get to more than a drachm a day, and that only by raising it very gradually from a five-minim dose. The liniment can be made with olive oil instead of lime-water; in the writer's hands the Chaulmoogra oil appeared to be more useful than Gurjun, but in the tropics Gurjun is most valued. Simple oils are also useful for a liniment, and greasy applications always seem grateful to the leper. Besides direct medication, frequent baths are to be used, and strict attention to general hygiene should be paid. Sulphur baths are strongly recommended by some, and since scabies is a very common complication it has a double advantage. The patient should be well and suitably clad, according to the climate, and chills carefully avoided, as they frequently seem to determine a fresh exacerbation.

When the febrile exacerbation is present, full doses of quinine should be given, such as gr. v. of the hydrochlorate every four hours; the strength should be carefully supported by highly nourishing diet, and hot baths are here specially useful; cod-liver oil, after the febrile symptoms have subsided, is beneficial. It is an exploded error that there is any disadvantage in healing the sores as soon as possible, and they should be treated on general antiseptic principles, iodoform and wet boracic acid lint, e.g., are good applications, but when ulceration is very extensive, finely carded oakum over a simple dressing is cheap and efficient, and prevents the fœtor which too often poisons the air of asylums. Most authorities recommend a change to a temperate climate, and certainly patients should be removed from districts where the disease is endemic. There can be but little doubt, however, that cold and variable climates have an unfavourable influence by increasing the liability to chills. In some cases of non-tuberculated lepra, stretching the affected nerve has been beneficial, the anæsthesia and paralysis having been relieved by it. As preventive measures, strict segregation is the only effective plan, and it is probable that the disease was stamped out of England and the greater part of Europe by this means, and the same result will probably be attained eventually in Norway by this procedure.

Those who have to dress the sores of lepers should be very careful if they have scratches or abrasions, and not neglect carbolic acid ablutions afterwards.

H. Radcliffe Crocker.

ELLIS'S SPLINT, for fracture of the clavicle, consists of a well-padded crutch for the axilla, which is supported in position by straps passed from its lower extremity over the opposite shoulder; the arm is held to the side by a transverse strap, and the forearm is supported in a sling.

Bilton Pollard.

EMBOLISM.—The plugging of a vessel by clot or foreign substance set free from some distant part of the circulation.

The process is to be regarded as one of the most important in pathology, not only on account of its direct effects, but from the *rôle* it plays in the occurrence of metastatic or secondary deposits in septic and malignant diseases. It differs from thrombosis in occurring mainly in internal organs and in the arterial system. Venous embolism is met with almost solely in the portal circulation.

Origin and Nature of Emboli.—1. Venous thrombosis is by far the most common source, parietal clots being the most dangerous. Such emboli are usually made up of laminated clot, a careful examination of which will often allow their primary origin to be determined. In some cases they may be found to correspond exactly with the broken end of a coexistent thrombus. Venous emboli commonly originate from the femoral, iliac, pelvic, renal, or jugular veins.

2. Arterial thrombosis.

3. Vegetations detached from the cardiac valves, or portions of clot broken off from coagula formed in the auricular appendages or the spaces between the muscular trabeculæ.

4. Vegetations detached from the surface of the large arteries in advanced atheromatous disease, or portions of clot set free from the interior of an aneurism.

5. Blood-clot developed as a result of intravascular injections in surgical treatment.

6. Portions of new-growth set free in the general circulation.

7. Parasitic cysts, particularly hydatids, developed in the liver, and passing by the inferior vena cava to the lungs.

8. Fat set free by extensive laceration of adipose tissue. *See* FAT-EMBOLISM.

9. Air entering by a cut vein. *See* AIR IN VEINS.

Emboli may be simple, septic, or malignant. Simple emboli only will be treated of here; for further details respecting septic or malignant emboli the articles on PYÆMIA and MALIGNANT DISEASE must be consulted. They may be single or multiple; and primary and secondary emboli are spoken of, the latter taking their origin from the thrombus developed around the primary one. The origin of an embolus, as a general rule, determines its destination. Those from the veins or right heart are commonly arrested in the pulmonary circulation, those from the left heart or arteries in the systemic circulation, and those from the portal system in the liver. Exceptions to these general rules may occur; minute emboli may traverse the pulmonary capillaries, and, gathering clot as they go, become arrested in the systemic circulation; and this is a more probable explanation of hepatic abscess in septic cases, where the origin of the process is in the systemic veins, than the gravitation theory; or larger emboli may, rarely, pass from the pulmonary to the systemic circulation, as a result of congenital deficiency, as a patent foramen ovale. The bifurcation of a vessel, where a sudden decrease of lumen occurs, is the most common point of arrest; this may, however, depend on the shape of the clot: a rounded clot usually lodges in a single vessel, but an elongated one may ride on the bifurcation, only becoming an obstructing embolus when fresh clot has been deposited. Where a large artery breaks up into several branches of about the same calibre (e.g. pulmonary), two or three may be thus, at first partially, then completely, occluded.

RESULTS OF EMBOLISM.—These are twofold in nature: 1. Local, consisting (*a*) in changes in the vessel itself, and (*b*) in the area supplied by it. 2. General, due to disturbance of the general economy from interference with the function of the organ or part supplied. The process is to be regarded as much more serious than thrombosis because of its sudden nature, which, even under the most favourable circumstances, renders anæmia of more or less extended duration inevitable. The results vary according to the size, number, and character of the emboli, also as to the importance to the general economy of the part or organ affected, and to the existence of a competent collateral circulation. Size is of importance chiefly in regard to the calibre of the vessel occluded and the consequent extent of the area affected; number has a similar import; but the character of the embolus is much more serious, as the principal determining point in the changes likely to ensue.

(1) *Local changes* (*a*) *in the vessel itself.* The more or less serious nature of these depends in great measure on the character of the embolus. The first change is secondary thrombosis, extending backwards and forwards to the next collateral branch, or in terminal vascular systems as far as the capillaries. This is followed by an endoarteritis of varying intensity and character. If the clot be of a simple nature the thrombus may organize, and, passing through the usual stages, the vessel either becomes permanently occluded, or its lumen may be more or less perfectly re-established, with a varying amount of thickening of the wall. If the embolus be derived from a clot undergoing regressive change, more extensive inflammation, involving periarteritis, may result; or, if it be septic, an abscess is the constant sequence, without necessarily precedent formation of an infarct. A rough or irritating embolus may, from the local injury or inflammatory softening induced serve as the origin of aneurismal dilatation.

(*b*) *Changes in the area supplied.*—These are threefold in degree: 1. More or less transient anæmia; 2. Infarction; 3.

Necrosis. The most important factors in the determination of the degree of damage seen in the area supplied are the richness of the collateral blood-supply, the strength of the general circulation, and the tendency to degeneration of the special tissue contained. Where the collateral circulation is free, as in the extremities, a temporary anæmia similar to that seen after ligature is in most cases the only result; but this fortunate termination is, as in the case of ligature, dependent on the force of the cardiac action and the capability of the collateral vessels to enlarge; if either of these factors is defective, extensive arterial thrombosis may follow, leading to partial or total gangrene. Certain organs, however, are furnished with a so-called terminal circulation. This arrangement, met with in the spleen, kidney, brain, and lung, is the chief determining influence on infarct formation, the gradual or sudden occurrence of occlusion being rendered irrelevant, as no sufficient collateral channels exist for the re-establishment of the circulation. Congestion and infarction may, however, be hindered or prevented in these cases if the distal veins be provided with valves, in the case of the large veins, by the weight of the column of blood, by distal thrombosis preventing regressive flow, or if the embolus be not completely obstructing. In organs mainly supplied by one artery the blood-pressure in the corresponding main vein is too low to allow a regressive current to develop; and here necrosis may be due to pure anæmia without hæmorrhagic infarction.

Infarcts may be red (hæmorrhagic) or white. The red infarct, met with most commonly in the lung, consists of a wedge-shaped area of dark red congested tissue, within which a considerable escape of blood-elements has taken place by diapedesis. The base of the wedge is at the surface, the apex corresponds to the obstruction. It is developed in the following manner:—The first effect of the occlusion is anæmia of the supplied area; the arrest of blood-supply, with the consequent removal of the *vis-a-tergo* normally exerted on the blood in the veins, is followed by a retrogressive flow of venous blood, the stasis thus induced being succeeded by the escape of blood-elements through the vascular wall, probably rendered more easy by changes in it dependent on its deprival of properly oxygenated blood. In the white infarct met with in the kidney and brain, congestion and hæmorrhage take no part; the colour here depends on local anæmia and the loss of natural transparency due to the condition of coagulation-necrosis induced by want of blood-supply. Further changes take place in either variety of infarct; in vascular tissue, as lung, a considerable amount of reactive inflammation, running on to suppuration, may occur; and in this or other tissues necrosis may follow. In cases of septic embolus necrosis and suppuration are inevitable. In cases of simple infarction, however, the changes, if the lesion has not been so considerable as to cause death, are of a gradual regressive character. The infarct becomes enclosed by a wall of inflammatory new-formation, and the framework of the wedge itself becomes permeated by infiltration of a similar character; where a secreting organ is affected the special cells die and eventually disappear. The process having reached this stage, vascularisation and development of connective tissue usually follow, and this is succeeded by the cicatricial changes noted in other scars. In some cases, however, so high a degree of development not being reached, caseation or fatty degeneration takes place throughout the affected area.

2. The *general effects* of embolism furnish the symptomatology of the process. The symptoms naturally depend entirely on the organ affected; they are primarily those of interference with the natural functions, more or less transient, at times followed by signs of inflammation or necrosis, at others by permanent and complete loss of function. The artery affected determines the gravity of the symptoms in any given case. Thus embolism of the coronary or of one or more of the large pulmonary arteries may lead to sudden death, of the cerebral arteries to more or less permanent and extensive paralysis, of the arteria centralis retina to blindness; while the functions of the lungs, kidneys, liver, and spleen may be more or less interfered with. Embolism of the spermatic artery is of special surgical interest, from the fact of its so commonly being followed by infarction and gangrene of the testis.

Treatment.—No general rules can be laid down for curative treatment, which will depend entirely on the organ affected. In the case of gangrene of the limb following embolism, and consequent arterial thrombosis, time should be given for the restitution of the vascular lumen before amputation is decided on. The more important general point is that of prophylaxis—that is, to observe the greatest caution in disturbing vessels in which clots exist; for instance, to avoid all unnecessary handling in cases of fracture of the thigh or leg in which thrombosis of the deep veins may have followed the injury; to follow the same rule in cases of phlebitis or of aneurism; to be careful that patients do not make active use of muscles after operations for varicose veins or varicocele; and in any case where injections of fluids capable of coagulating the blood are used, to employ compression on the distal side of the circulation.

G. H. Makins.

EMMET'S OPERATION or TRACHELORRHAPHY.—These terms signify the repair of a laceration of the cervix uteri by a plastic procedure similar, in many respects, to those which have long been employed by surgeons for the cure of ruptured perineum and vesico-vaginal fistula. The discomforts produced by these latter conditions are well known, and can be remedied by plastic operations. The advocates of Emmet's operation believe that many severe pelvic symptoms, and many morbid conditions of the uterus, are produced and aggravated by laceration of the cervix; and they further declare that the operation in question effectually remedies the evils which they believe to be caused by an unhealed rent in the cervix uteri. It has been asserted that when the cervix has been torn during labour, subinvolution of the body of the uterus will almost inevitably ensue, with concomitant hypertrophy of the cervix, since the solution of continuity in the cervix seems to interfere with the absorbents, and to arrest the metamorphosis of tissue necessary for a proper involution.

Retroversion is believed by many to be an almost equally constant result of laceration of the cervix, which is said to destroy the symmetry of support given by the attachments of the uterus, the body of which organ being, in such cases, in a condition of subinvolution, becomes topheavy and liable to fall backwards. Dr. Emmet himself holds the theory that the condition once known as ulceration, and now generally held to be abrasion of the os uteri, is really laceration of the cervix, with consequent ectropion of its mucous membrane. The constant friction of the everted tissues sets up much local irritation and discharge, and, if long continued, may cause epithelioma. Here it must be observed that very high authorities have described undoubted cases of cancer of the uterus beginning on a lacerated surface on the cervix, although it is far from true that malignant disease of that part of the uterus arises solely from lacerations. The precise significance of the ectropion described as a result of laceration, as well as the true relation of subinvolution, retroflexion, and uterine discharges to that lesion, have been the subject of much dispute, and the arguments on these questions, and on the advisability of Emmet's operation, will be found in current British and American text-books on diseases of women, and in the recent reports of obstetrical societies.

Some of the advocates of Emmet's operation recommend, as in the assumed homologous cases of ruptured perineum, that if laceration of the cervix be diagnosed after labour, it should at once be washed, and its edges carefully united by wire sutures. This proceeding is said to check hæmorrhage, to lessen the chances of puerperal fever through absorption of discharges by the raw surfaces of an ununited laceration, and to save the patient from much unnecessary trouble, as she may thus recover from parturition and trachelorrhaphy at the same time.

It is when a laceration of the cervix not only exists, but is associated with ectropion of the mucous membrane, and other signs of local uterine disease, that Emmet's operation is considered advisable and justifiable by its advocates in this country. The patient should wear a Hodge's pessary for a short time before operation, and a hot-water injection should be administered every morning and evening. For the operation, it is advisable that the patient should lie almost on her left side, but with her face and abdomen turned somewhat downwards; the knees are then drawn up, the right rather higher than the left. A Sims' speculum is then introduced, so as to elevate the posterior wall of the vagina, the anterior wall falling forward by gravitation, owing to the position of the patient; a Sims' depressor will aid in pushing the anterior wall still further forwards. The attitude in which the patient is placed is known as 'Sims' position.' Many operators, however, prefer the more familiar lithotomy position. The lacerated flaps are then seized by tenacula, and, holding one of these instruments in the left hand, the operator makes a perfect raw surface on one flap, cutting up to the angle made by the divergence of the flaps. The opposite flap is then treated in the same manner. Hæmorrhage must be checked by pressure, and the flaps approximated. The sutures are then introduced, from above downwards, by a special needle, which should be entered at some distance from the margin of one flap and brought out through the opposite flap; it bears a loop of silk, by means of which a silver wire is drawn backwards along the back of the needle. The sutures are lastly twisted, one by one, beginning from above, and bent downwards before the ends are cut short. When the laceration extends to both sides of the os, the flaps must be vivified on both those sides, care being taken to leave untouched a strip of tissue running along the middle of each flap, from the free edge up to the opening of the cervical canal, so as to form an os externum.

When there is much hypertrophy of the tissues of the lacerated surface, the overgrown cicatricial tissue must be freely cut away, so that the denuded flaps may be readily approximated. In the case of multiple or stellate lacerations, the mucous membrane may be cut away in such a manner as to form one raw surface on each side of the os, as in the case when a bilateral laceration is vivified, the precautions with regard to the os being remembered.

After the operation the vagina must be cleansed daily by antiseptic injections, the bowels kept open, and the sutures removed at the end of a week, beginning with the uppermost; the lower may be left in for a week longer if necessary. In a successful case, the cervix will appear, after the patient's recovery, like that of a virgin, or nulliparous woman. Statistics are as yet wanting to prove whether the repair of the cervix be, as a rule, permanent or only temporary, not resisting subsequent natural labours. ALBAN DORAN.

EMMETROPIA. — The condition of normal vision, when the eye is fully capable of being readily focussed for both near and distant objects.

EMPHYSEMA.—In surgical writings, by 'emphysema' we understand the extravasation of air into the areolar tissues of the body. It must not be confounded with the medical term 'emphysema of the lung,' which is a dilatation or rupture of the normally existing air-vesicles of the lung, whereby they become greatly increased in size. Surgical emphysema may be recognised by the swelling of the affected part, and by the crackling sensation communicated to the fingers on placing the hand upon it and making gentle pressure in different directions. It is mostly produced by a wound of the lung, bronchus, or trachea; but is occasionally found in non-penetrating wounds of the thorax.

Emphysema is occasionally, but rarely, seen in wounds of parts other than the chest. Thus in the limbs, in wounds of a crushing or lacerating character, air is sometimes forced into the tissue at the time of the accident. The feeble vitality of the crushed tissue, together with the extravasation of air, makes these cases of more gravity than the nature of the wound would indicate; but if vital parts be not injured, they mostly do well in the end. Such emphysema must be distinguished from the emphysema of decomposition, which is occasionally seen in similar cases, as a preliminary to acute gangrene taking place in the part. In such cases the prognosis is exceedingly grave. The one condition may pass into the other if the injury be severe, and thus the recognition of the state may at first be rendered difficult. But the swollen, dark red appearance of the part affected with the emphysema of decomposition, together with the speedy formation of livid patches upon the surface, will dispel any doubt that may be entertained. Very free incision into the part so affected is the very least that can save the patient, and if it be a limb in which the condition occurs, the expediency of immediate amputation will have to be considered.

Emphysema also occasionally occurs from wounds or fistulæ in connection with the alimentary canal. Thus the writer has seen it occurring very extensively about the buttock in a case of ordinary anal abscess. In such a case there is usually an ulcer through the wall of the rectum, and the peristaltic movement of the intestine forces some of the intestinal flatus through this aperture into the areolar tissue of the ischiorectal fossa, from which it spreads to the surrounding integuments.

But by far the most frequent cause of emphysema is fracture of one or more ribs, by which the lung has been wounded. It is occasionally complicated with pneumo-thorax—i.e. air in the pleural cavity—and sometimes even with hæmothorax. In such cases, in the movement of inspiration, air gets sucked into the pleura, and in the succeeding act of expiration is squeezed into the subcutaneous cellular tissue. Emphysema produced by such a cause is of moderate extent, and generally absorbs rapidly and completely. But emphysema often occurs without the complication of pneumo-thorax. This most frequently takes place in young people, especially when the wound of the chest is small, and has a valvular character. It is produced by the wounded surface of the lung becoming opposed to the wound in the pleura, so that, in the movement of expiration, the air is squeezed directly out through the pleural wound under the integuments. Where the lung is fairly healthy the tendency to retraction is but small. Thus, even in an extensive incised wound of the thorax, where the lung has been exposed, pneumothorax is not necessarily produced. In such cases the lung has been seen moving, in each act of respiration, against the thoracic parietes, and the pleural cavity remaining free of air. The cases of hernia of the lung are also illustrations of the same fact.

Sometimes the emphysematous condition of the tissues is not found at the seat of injury, but at the root of the neck. This is generally considered as a sign that the root of the lung has been injured, and that the air has extravasated into the posterior mediastinum, and has thence travelled upwards into the root of the neck. Although this may be a correct interpretation of the facts in some cases, it does not appear to be so in all. In some cases emphysema at the root of the neck appears to be due to rupture of the air-vesicles at the upper part of the lung, directly under the dome of the pleura, this being the direction of least resistance when any violent expulsive effort is made upon the chest-cavity. When adhesion exists in the pleural cavity, as is frequently the case, the direct passage of the air from the injured lung to the surrounding areolar tissue is rendered easy, without the possibility of the formation of any pneumothorax. But without this aid, in severe compression the force will often be sufficient to rupture both lung and dome of pleura, and thus extravasate air into the root of the neck.

Emphysema may vary most immensely in amount, from those slight cases in which only a little crepitation is felt under the skin, to those extreme ones where the whole body is blown up like a sausage, threatening death every instant from the difficulty of respiration, and from impeded action of the heart.

Treatment.—In the great majority of cases the emphysema is best left alone. The most extensive extravasations will absorb and get well of themselves, if left quietly to nature. Only in those cases in which death is impending from suffocation, or impeded action of the heart, is surgical interference called for. In such cases, however, it should be prompt; it may be sufficient in some cases to puncture the skin in many points with a fine trocar and canula, and thus allow the air to escape; but in others this will not be quick enough in the relief afforded, and in these it is better to make several small incisions through the skin in different parts of the body, so as to allow of the rapid exit of the air. The relief thus afforded is very great; the swelling rapidly subsides, and the patient returns to his normal appearance.

The *prognosis* in all these cases is very favourable. Even in the very severe forms above described, where surgical treatment is necessary, the incisions heal, and the patient gets well very rapidly.

H. G. Howse.

EMPROSTHOTONOS. *See* Tetanus.

EMPYEMA.—The word 'empyema,' though it has sometimes been more loosely employed, should only be used to describe a collection of pus in the pleural cavity.

It is essential for the surgeon to appreciate the various causes which may give rise to this condition, because his treatment to some extent, and his prognosis very largely, will depend upon this consideration; but it would be beyond the scope of a surgical work to give more than a brief enumeration of these causes.

Causes.—1. *Traumatic.*—Two kinds of injury may be followed by empyema—a penetrating wound of the chest, with or without injury to the lung, and a contusion of the chest-wall, with or without fracture of rib or injury to lung. The former includes gunshot wounds, thus possibly involving the presence of a foreign body in the pleura, and results most likely in a septic empyema; it may be accompanied by the presence of gas in the pleura—pyopneumothorax, due either to the entrance of air from without through the external wound, or from within, owing to a wound of the lung, or to the presence of the gaseous products of putrefaction. The latter arises in some not easily explained manner, and is a rare sequence of such injuries; it is probably, in most cases, the consequence of a serous effusion or hæmorrhage resulting directly from the injury, and may, if the lung is injured, be a pyopneumothorax.

2. Empyema may be the outcome of a simple serous effusion, occurring, perhaps, as a result of exposure to cold or wet, or during or after any of the acute fevers, or in the subjects of the rheumatic, and, still more, the tubercular diathesis; but it seldom or never follows the dropsical effusions which accompany some diseases of the heart and kidneys. Under this heading, perhaps, should be included the purulent effusions that occur in the

course of attacks of septicæmia, which are often bilateral.

3. It may be caused by an extension of inflammatory mischief from the lung; this may be of several kinds—e.g. the pleurisy accompanying acute pneumonia, or that which forms around the embolic abscesses of pyæmia; or the rupture of a gangrenous patch in a pneumonic lung, or that of a tubercular vomica, or, again, it may be the result of the presence of a foreign body which has been inspired into a bronchus.

4. An empyema may be the consequence of rupture into the pleura of morbid materials from other situations; such, for instance, as a hydatid of the liver, a hepatic or a pericæcal abscess, or an abscess connected with disease of the ribs or sternum, the cervical or dorsal vertebræ, or a mediastinal gland; or it may result from the burrowing downwards of pus after cut-throat or tracheotomy, or after injury or disease of the œsophagus, or of other structures in the neck.

Varieties.—An empyema may be universal or localised—that is, the collection of pus may be free in the pleural cavity, or it may be circumscribed by adhesions between the visceral and parietal layers of the pleura. In the latter case there may be more than one collection on the same side of the body, e.g. one between the base of the lung and the diaphragm, and one in another part of the chest. The signs will thus vary in different cases; but the typical ones, all or some of which may be present, are (*a*) a general distension of the affected side, with bulging of the intercostal spaces, so that the outline of the chest on the affected side becomes more circular than normal; (*b*) more or less immobility of that side; (*c*) dulness on percussion over the position of the fluid. This dulness is fixed in a localised empyema, but if it be not localised will vary with the position of the patient unless the collection of fluid is very large, in which case the chest will be completely dull both in front and behind. (*d*) Absence of breath-sound, vocal fremitus, and resonance over the fluid. The first of these is a very untrustworthy sign, especially in children, bronchial breathing being often heard over the whole of the dull area. It is important to notice that the breath-sound on the affected side is almost always decidedly weaker than on the sound side. (*e*) Displacement of the viscera —i.e. of the heart away from the affected side, and of the liver or spleen downwards. (*f*) More or less dyspnœa, generally relieved by placing the patient on the affected side. (*g*) A varying amount of fever, the evening temperature being usually much higher than that of the morning, but the total amount of elevation being very inconstant. (*h*) If gas be present in the pleural cavity there will be the usual signs of pneumothorax; and (*i*) if there be an opening between the pleura and the lung, there will be more or less purulent expectoration. (*k*) In old cases retraction of the side occurs without any evacuation of the contents, as a result of the absorption of some part of the pus. This retraction is not inconsistent with the presence of a large quantity of pus in the pleural cavity.

Diagnosis.—It will thus be seen that the diagnosis of an empyema from a simple serous effusion or hæmothorax, or from certain pulmonary conditions, is often very difficult. In all cases, but especially in doubtful ones, the surgeon should clench his diagnosis by inserting through an intercostal space the needle of a small exhausting syringe, or—what answers the purpose equally well—a fine exploring trocar. This, if the skin and the instrument have been efficiently purified by an aqueous solution of carbolic acid (1 to 20), can do no harm; but if this precaution be not used, or if reliance be placed on that very untrustworthy material, carbolised oil, a simple serous or sanguineous effusion, or an aseptic empyema, may be converted into a collection of fœtid pus. An advantage claimed for the exhausting syringe over the exploring trocar is that sometimes the withdrawal of a small quantity of fluid has seemed to start the process of absorption, which afterwards has continued until all the pus has disappeared. It is obvious that the presence of pus should be placed beyond doubt before any operation for its evacuation is attempted.

Age at which it occurs.—Empyema may occur at all ages, and is a common disease of children.

Contents.—Empyemata vary very much in the nature of their contents. Sometimes the fluid is thick, often very thick, pus; sometimes it consists of a turbid material mixed with flakes of lymph, and in the instances where serous effusions become in time purulent, it is clear that all the stages between serum and pus must be passed through at one period or another. Again, while the contents of an unopened empyema are mostly free from putrefactive smell, those of one which communicates with the lung or with the exterior of the body, or which has arisen by the burrowing of pus from around the cæcum or other localities, may be septic in the highest degree. It is not improbable that many cases of turbid effusions containing flakes of lymph undergo spontaneous absorption, and it is certain that the same process may occur, and possibly does so, more often than we suspect in cases where the fluid is true pus. Still, the occurrence is not common enough to warrant the surgeon in ever waiting for it to take place. It is not intended by this to state dogmatically that all empyemata should be opened or even aspirated; for it appears that, in some phthisical subjects, such a proceeding actually accelerates the disintegrating process that is going on in the lung. In these cases, however, the collection of fluid is left alone, though not in the hope that it will be ultimately absorbed.

There are, however, other conditions in which delay is recommended: namely, those in which an internal opening for the exit of the pus has been formed; such cases follow sometimes, though not always, a very favourable course. The directions in which a spontaneous rupture may occur are as follows: (*a*) into the lung, in which case the empyema may be expectorated; (*b*) into the stomach or intestine, when it may be passed with the stools; (*c*) behind the deep fascia of the abdomen, when it may burst into the peritoneum, or, as is more likely, may point through the abdominal wall or at the groin, or even at a lower point in the lower extremity; (*d*) the most common position, viz. through the thoracic parietes. The opinions of various observers differ very much as to the commonest seat of spontaneous rupture, some assigning the second or third interspace in front, some the fifth interspace near the junction of the rib and cartilage, and others still farther towards the back. The writer has seen examples of all, but perhaps more high up in front than in any other place.

Treatment.—If spontaneous rupture have not occurred, no time should, in the great majority of cases, be lost in evacuating the fluid, for the longer it is left the more will the lung be disabled by compression, and the less will its expanding power be able to come into play. For this there are two methods—*aspiration* and *free incision.* There are strong arguments both for and against aspiration. In favour of it, it may be said that a certain number of cases, especially in children, are undoubtedly cured by this method, sometimes by a single tapping, but more often after it has been repeated two or three times; and, if it do succeed, the cure is more rapid, an open wound is avoided, and a complete collapse of the lung is possibly prevented. It should be remembered that a cure taking place by this means almost necessarily involves the absorption by the pleura of a certain amount of pus; for it is clear that unless the lung be at the time of aspiration capable of complete expansion—a not very likely condition—it is almost impossible, by the most forcible exhaustion, to empty the chest completely. And, indeed, the operator should not make this his object, but should stop the exhaustion if the patient begins to cough, or if any blood appears in the syringe. If, after aspiration, the fluid steadily reaccumulates, the operation should be repeated after a not longer interval than a week, and if after two or three aspirations a cure does not seem to be taking place, the writer would advise that a free incision should be made without delay. Against aspiration it may fairly be said that in the majority of instances it is unsuccessful, and, if it fail, precious time, as regards the condition of the lung, will have been wasted; and it should be added, that in the cases in which it is most likely to succeed, viz. children, the free incision is a highly satisfactory operation.

Aspiration.—It is not necessary to give the details of aspiration, which will be found under ASPIRATION and ASPIRATOR. The following practical points may, however, be mentioned:—The surgeon, will, of course, be careful to carbolise, not only the skin, but the outside and the inside of the canula. The latter object is best attained by drawing some carbolic acid solution through the syringe. Care must also be taken to avoid wounding the lung with the point of the instrument. At the end of the operation it is not unlikely that the canula may be obstructed by contact with the lung; if this occur, its point should be directed downwards and backwards towards the lower part of the chest. It will be found most convenient to employ the bottle aspirator, and to continue the process of exhaustion as the fluid flows, rather than to make several successive vacuums, so that an excessive negative pressure may not be exerted at any time upon the contents of the pleura. A long canula and trocar, so arranged that a blunt plug can, if necessary, be substituted for the trocar, for the sake of clearing the canula without allowing the entrance of air, is recommended in preference to a perforated needle. Such canulæ, which cannot injure the lung as it expands, are supplied with many of the French aspirators. In some cases it will be found convenient to make a minute puncture in the skin with the scalpel, so that the canula may be introduced without a jerk. The puncture is afterwards to be closed with collodion, or if oozing take place, an antiseptic dressing is to be applied.

Free incision.—If it be decided to make an incision into the chest, all are agreed that the opening should be a free one; but opinions vary very much as to the best way of making this opening.

1. *Position of opening.*—If the matter be already pointing, it is well to evacuate the subcutaneous collection, whether a second opening be made or not. If the surgeon be free to choose the spot, he may select that which in modern text-books is described as the seat of election, viz. the sixth or seventh interspace, just in front of the posterior fold of the axilla; or that recommended by Mr. Marshall, viz. the fifth interspace, just external to the cartilages (following, according to the wide experience of this surgeon, the most common seat of spontaneous rupture); or he may select a point further back, as was done by the older surgeons, viz. the eighth or ninth interspace, slightly external to the line of the angle of the scapula. This is the position which, in the writer's opinion, is—always in children, and usually in adults—the most advantageous. Or, lastly, he may make the opening low down behind, in the tenth or the eleventh interspace. There are obvious objections to the last of these plans. 1st. The lower limit of the pleura behind is liable to considerable variation. 2nd. This part of the cavity is sometimes obliterated by adhesion of the two pleural surfaces, although the upper part of the space is filled with fluid. 3rd. The lower part of the pleura is that which in successful cases is the first to close, and, when this occurs, the efficiency of the drainage-tube and its easy introduction is much interfered with by the upward direction imparted to it by the pressure of the diaphragm. No rules can be laid down for the position of opening a localised empyema.

2. *Method of incision.*—A free opening may be obtained either by making a long incision in an intercostal space, or by making a shorter incision and removing a portion of rib. The former is rather the simpler operation, and is recommended in cases where the intercostal space at the point selected is sufficiently wide, and should, if possible, be adopted if the matter is putrid; the latter has considerable advantages, which will be stated below.

The patient should be placed at the extreme edge of the operating table, and as nearly as possible on his back. If he be rolled on to the sound side, the breathing may be seriously interfered with if he be under the influence of an anæsthetic, and if there be a communication between the pleura and the lung, there is danger of the expectorated pus passing into the bronchi of the healthy side, and setting up serious mischief there. The writer prefers chloroform to ether for the anæsthetic, on account of the occasional inconvenience, or even danger, from the excessive secretion of bronchial mucus which may sometimes result from the latter. The arm should not be raised to more than a right angle with the trunk, as otherwise the skin is inconveniently displaced. By drawing it up to this level the skin will be slightly raised; the operator should notice the extent to which this has happened, and must make his preliminary incision proportionately above the intercostal space; he may, in most cases, divide the structures with one sweep of his knife down to the rib above the space. If this precaution be neglected, the opening will be found to be inconveniently valved when the arm is depressed.

The incision should be two or three inches long, the length depending upon the size of the patient. If, after the deep incision has been made, it is found that it does not quite correspond to that in the skin, the after-treatment will be greatly facilitated by making the latter T-shaped, the vertical cut being made upwards or downwards as the case may require. After the hæmorrhage has been stopped in the superficial parts, the intercostal space is explored with the finger, and the knife is directed to the rib bounding it below, and is carried along its upper border through the intercostal muscles and the pleura. In this way the intercostal vessels which occupy the groove on the under surface of the rib are effectually avoided. If more convenient, the deep incision may be made short in the first place, and afterwards enlarged by expanding the blades of a pair of dressing-forceps inserted into it. The finger is then passed through the intercostal space, to explore the cavity and ascertain that there are no flakes of lymph obstructing the rest of the pus, or other peculiarities of the case requiring attention, and then the matter is allowed to escape freely. It is well, if the operation be performed antiseptically, to place a piece of rag soaked in carbolic solution over the wound during the escape of the pus. If an intercostal artery be wounded, one of two courses may be pursued; either the finger may be pressed upon the wounded vessel, which will arrest the hæmorrhage in the course of a few minutes, or the surgeon may at once proceed to the removal of a portion of the rib behind which the artery is situated, as will be described in the next section, and the artery will be secured without further difficulty.

3. *Removal of rib.*—The operation of removal of a portion of rib is performed in this way. The incision is made as before, but at a somewhat higher level, through all the soft parts, including the periosteum and the rib. The transverse cut is in this case almost essential. The periosteum is then raised from the rib by means of a periosteum-elevator, a very convenient form being that of a short chisel, with a transverse steel handle. A very blunt and slightly curved periosteum-elevator is then slipped between the deep surface of the rib and the periosteum, without rupturing the latter, and when by this means a piece of rib 1½ inches long has been completely denuded, and is pressed forward by the elevator held beneath it, the denuded portion is cut away, either by means of strong bone-pliers alone, as may usually be done in a child, or after first sawing it pretty deeply with a small saw, as is sometimes necessary in the adult. A special forceps for the purpose has been introduced by König, having one blunt and grooved blade for slipping beneath the rib, and the other a sharp blade, which, when the blades are closed, fits into the groove on the deeper one. After the portion of rib has been removed, the periosteum can be divided at leisure, and exactly in the required position, without any fear of wounding the intercostal artery. If the periosteum be very thick, a short vertical cut upwards will free the opening in a most satisfactory manner.

In urging this method of procedure as a uniformly good plan in children when the opening can be made behind, and in all cases where the ribs are close together, the writer simply maintains — 1st. That an opening is obtained sufficiently large to enable all flakes of lymph and solid material to escape, and to allow of the introduction of the finger, with the object of ascertaining the state of the cavity and the possible presence of other localised collections of matter in the immediate vicinity of the incision. 2nd. A drainage-tube of large size can be introduced, and on future occasions it can be removed and reintroduced without discomfort to the patient. The operation is not recommended from any idea that it will favour the falling in of the chest, such a result being quite out of the question. The continuity of the rib is re-established within a few weeks, and the writer has not, after considerable experience, found any inconvenience from non-union of the rib or excessive formation of callus. The latter condition has, however, in the hands of some surgeons occasionally led to difficulty in the performance of other operations which have been deemed necessary—a difficulty, however, which has been easily overcome.

Drainage-tubes.—Much space would be required to describe all the varieties of tube which have from time to time been devised and recommended. The writer always employs a very simple tube first recommended by the late Dr. Baxter, which anyone can make for himself, and which will be found invariably efficient. The end of a piece of indiarubber tubing, varying from a quarter to half an inch in diameter in accordance with the size of the cavity, is split into four pieces. These four pieces are drawn through a hole rather larger than the tube, cut in a piece of caoutchouc $\frac{1}{10}$ to $\frac{1}{12}$ inch in thickness, and about 1½ inch square; they are then turned down and each of them is fixed to the flat piece by a stitch of silver wire, the ends of the wire being twisted and turned down flat. A flanged tube is thus produced, the flange serving the double purpose of keeping the tube in position and preventing the possibility of an untoward accident that has occasionally happened, viz. the slipping of the tube into the chest. Flat tubes, double tubes, and solid tubes, made of silver or vulcanite or celluloid, have their special advantages in certain cases, and may be devised to suit particular conditions. The length of time for which the tube should be retained depends upon the amount of discharge; when this becomes very small, a tube of smaller calibre may be substituted for the first, but no definite rule with regard to time can be laid down in adults. In a simple, uncomplicated case in a child, it will often be found advantageous to withdraw the tube either at the expiration of, or soon after, the end of the first fortnight; but if, after doing so, the temperature should rise or the discharge increase, the tube should be reintroduced without delay.

Sometimes a second opening seems desirable, either at first or when, after a time, it is found that matter continues to collect at the posterior and lower parts of the pleura. Such a second opening may readily be made by passing a stout and long probe or metal bougie from the first opening to the selected spot, and cutting down upon its end, which is made to project through an intercostal space.

If the temperature remain normal, the patient should not be kept in bed after granulation is fairly established; the change of position, and the greater movement of the chest-walls resulting from the alteration of position favouring the complete evacuation of the contents of the pleura.

The treatment of old cases of empyema, with contracted chest-walls and greatly thickened pleura, often presents almost insurmountable difficulties. If little or no falling in of the chest or expansion of the lung have occurred after the lapse of months, it may be said at once that almost any line of treatment will be unsuccessful; but if the pleura be reduced to a small cavity at the top of a long sinus, much may be done if it be remembered that it is the upper and not the lower part of the pleura which presents the obstacle to healing. In order to close the lower part great advantage may be gained by removing three or four inches of several (four or five) ribs with the subjacent thickened pleura. A flap, including all the soft parts, surrounded by a suitable angular or curved incision, must be turned off the rib, and then each one must be removed separately, following the directions given above for the removal of a single rib; the thickened pleura may then be freely snipped away with scissors, any vessel which is divided in the process being at once secured. But the bleeding, which is often free whilst the ribs are being exposed, in these old cases is generally quite insignificant during the later steps of the operation. The tube must then be placed in the upper part of the incision, and carefully maintained in this position. There will, however, generally be left a space included by the first or the upper two ribs, which cannot, owing to the structure of the parts, contract. The most satisfactory results under these circumstances will be obtained by making an opening at the first or the second interspace—a somewhat formidable and difficult operation. The cavity is thus reduced to a minimum, and is effectually drained by a short straight tube, which the patient himself can change without difficulty.

If an empyema have reached the chronic stage, and no advance is being made, or if the discharge be persistently putrid, great good may be obtained by injecting the pleural cavity with some stimulating or antiseptic material, of which, perhaps, the best is a solution of iodine. But great care must be employed in using this remedy, as many cases have been recorded in which sudden death has occurred during the process. For this reason injection should not be resorted to unless there seems to be a decided need for it. The safest and most satisfactory plan is to use an irrigator, best made from a glass bottle, with a hole admitting a cork in the side near the bottom. Through the cork is passed a rigid tube, communicating by means of an indiarubber tube some feet long, with a piece of gum elastic catheter, not large enough to fit tightly into the sinus. After introducing the catheter into the cavity, the bottle is to be raised very slightly above the level of the bed, and, if the catheter be not too large, the lotion will presently flow to some extent alongside it from the orifice of the sinus, and thus undue pressure will be avoided. But, if the patient begin to complain of a sense of distension, the catheter must be at once withdrawn and the fluid allowed to escape. The solution should be used warm, and if tincture of iodine be employed it should be made of about the colour of sherry. Condy's fluid, boracic acid and other preparations find favour with some surgeons, and in some hands the employment of the last-named drug methodically in the early stages of the treatment appears to have been followed by very satisfactory results.

No description will be given of the methods of dilating old sinuses by means of sponge-tents and other dilators, because such methods are seldom of use; nor will other plans of dividing ribs in these cases, with or without removal of a considerable portion of the centre, be detailed, because the writer has no experience of them, and the exact method of performing the operation will be suggested to the surgeon by the particular case. It is also only necessary to mention the fact that sponge-grafting has been said to have given satisfactory results, when employed with the object of filling up cavities which have proved very obstinate.

Prognosis.—As to prognosis, it may be said that, 1st, *cæteris paribus*, the longer the case has lasted the smaller is the chance of the lung expanding. 2nd. A localised empyema is more favourable than a general one. 3rd. The presence of lateral adhesions between the lung and the chest-wall is a good sign. 4th. The more rigid the chest-walls, the less chance is there of a cure; hence, as well as for other reasons, the prognosis is almost always favourable in a child, and generally unfavourable in those above middle age; hence, also, it is a good sign when the shoulder begins to drop and the chest to fall in. 5th. Tubercular cases are bad. 6th. Stinking cases are less favourable than those which are aseptic; though it must be owned that, especially in children, they often do equally well. 7th. There is a general impression, perhaps unsupported by sufficient evidence, that a right-sided empyema is a more serious affair than one on the left side. 8th. It does not seem that the previous bursting of the empyema into the lung has much influence in the prognosis; nor does rupture into the intestine necessarily prove a serious complication. 9th. Empyema on both sides of the body at the same time is almost necessarily fatal, unless one or the other be localised; except in those cases in which the purulent contents are absorbed. If a general empyema have been opened, and another form on the opposite side, it is obvious that the only surgical treatment for the second collection is by aspiration.

In speaking of prognosis, it must be borne in mind that an unfavourable result does not necessarily imply an immediate or even rapidly fatal issue. The result cannot be said to be favourable if a sinus remain, communicating with a cavity constantly discharging pus, though the patient may live in comparative comfort for many years, and only fall a victim at last to the gradual development of albuminoid changes. The writer has under observation a strong man whose empyema was opened nine years ago; he is now doing a good day's work as a costermonger, and is only recently beginning to show, by his somewhat pallid colour and clubbed fingers, that some of the changes hinted at are probably in progress. This peculiar pallid or earthy appearance may be noticed at much earlier stages of the disease.

Many empyemata, on the other hand, are much more rapidly fatal. Some of the tubercular cases die of rapidly advancing tubercular changes, or more rarely develop an empyema on the opposite side. The latter accident occurs in some of the septic cases, and these are also liable to die from the direct effects of blood-poisoning. A curious complication of septic cases must also be hinted at, viz. cerebral abscess, which, though it is difficult to trace any causal connection between the two conditions, has happened in a sufficient number of instances to make it impossible to overlook the possible association of one with the other.

Not the least common cause of death after empyema, however, is a slow process of exhaustion, in which the patient gradually sinks under the effects of the prolonged suppurative discharge. Two other very serious and not very uncommon complications of empyema are the occurrence of pericarditis and peritonitis.

It is impossible to conclude this article without expressing the belief that, although great advance has been made in recent years, we have not yet arrived at the best possible method of dealing with old chronic cases of empyema.

Rickman J. Godlee.

ENCEPHALITIS, MENINGITIS, and ABSCESS OF BRAIN.—Traumatic inflammation affects either the membranes or the substance of the brain. Meningitis is the term applied to the former, encephalitis to the latter. When it is wished to differentiate inflammations of the dura mater from those of the pia mater, the term 'pachymeningitis' is applied to the former, and 'leptomeningitis' to the latter. All inflammations of the surface of the head, arising either from idiopathic or traumatic causes, may lead to intracranial inflammation; but injuries of the brain itself are most likely to give rise to encephalitis.

Meningitis takes its origin from superficial lesions, such as inflammations of the scalp, injury to the bones and brain-membranes, the inflammation spreading inwards. Perforating injuries of the skull, involving the dura mater, are frequent causes of inflammation of these membranes. Caries of the petrous portion of the temporal is one of the most frequent causes of external pachymeningitis, and it ends, as a rule, in suppuration. It is said that when the dura mater has been detached from the interior of the skull by effusion of blood, inflammation is frequently set up in that membrane. The writer considers that pachymeningitis arising from such a cause must be rare, unless when the dura mater has been subsequently exposed to the unpurified air.

Encephalitis (traumatic) may arise in either of two ways: from injury to the brain-substance, such as contusion and laceration, or it may be secondary to meningitis. Inflammation, beginning in the brain, does not generally extend beyond the pia mater, and any effusion which might take place more superficially would be subarachnoid and not subdural, unless the inflammation were very severe. On the other hand, in pachymeningitis, the inflammation does not generally extend deeper than the arachnoid, the subdural space being more or less distended with turbid fluid. As a rule, the inflammatory action, commencing in the brain, affects the membrane next to it; and inflammation commencing in the scalp or skull affects the dura mater.

Meningitis may arise by the extension of inflammatory processes from the scalp to the interior of the skull. Erysipelas and diffuse inflammation of the scalp are in this way regarded seriously, as they are liable to lead to intracranial mischief. In fatal cases of this kind the upper portions of the hemispheres are found affected; the brain-substance and the pia mater being deeply congested, and this is accompanied by subarachnoid effusion of turbid fluid. These may be all the morbid changes that are seen. In chronic cases, such as may originate in caries or necrosis of the bone, the inflammatory processes may have gone no further than the dura mater, which has become thicker and more vascular than normal, and which may be adherent to the bone. Should the osseous inflammation extend, or become more acute, the dura mater may become softened and separated from the bone by plastic exudation or by pus. Molecular disintegration of a portion of the dura mater may ensue or a slough may be formed. It is unusual for the inflammation to extend in the dura mater centrifugally, or much beyond the area of the original injury, such as the affected bone, although it has been known to extend to the base. It is quite otherwise with the arachnoid. Once the arachnoid has become involved, there is rapid spreading of the inflammatory action, frequently involving the whole of the upper aspect of the vault on the affected side, though rarely extending to the base. In such cases the cavity of the arachnoid becomes distended, more or less, with inflammatory effusion, which is generally of a purulent character. The inflammatory action may spread to the pia mater, and when it does so there is almost necessarily an involvement of the cortical substance of the brain, which becomes softened, of a darker colour than normal, and adherent to the pia mater. This membrane becomes much thicker and more vascular, and occasionally the inflammatory action, when chronic, has so altered the appearances of the parts by reduction of the cells to their embryonic condition and by plastic exudation, as to render it difficult to draw the line between the grey matter and the adherent pia mater.

The manner in which the inflammation spreads inwards from without the skull, is stated to be through direct contiguity of structure. It is also supposed to spread along the veins which establish communication between the intra-cranial circulation and that of the scalp. The chief of these are the emissary, which pass through the principal foramina, likewise the facial and those of the diploe.

In encephalitis arising from contusion of the brain the pia mater is much thickened and infiltrated, and any exudation which may take place will be found on the cerebral side of the arachnoid. In this it is like idiopathic encephalitis, the cavity of the arachnoid being free from effusion, unless in most acute forms of inflammation.

The inflammation of the pia mater generally spreads all over the upper and lateral portions of the affected hemispheres. When the encephalitis occurs in the white substance after injury, it generally arises in a portion of the brain which has been contused, and where at least punctiform ecchymoses exist. It is assumed that when encephalitis follows concussion it begins in such an area of punctiform ecchymosis. These patches become the seat of inflammatory new-formation, giving a peculiar saffron colour to the affected part. A general softening of the brain-tissue ensues, which may pass on to the formation of an abscess. Though the affected areas do not extend further, as a rule, than the original seat of injury, still there are occasions when the inflammatory action spreads greatly, the tissue becoming diffluent. When pus is present, it is usually of a yellowish or yellowish-green colour. Occasionally it is brown and fœtid.

Diagnosis.—The symptoms are very variable, no two cases following exactly the same course. One of the most constant, as well as one of the earliest, is cephalalgia, the pain being either diffuse or localised to a particular region of the head, often corresponding to the part struck, though at times situated at the opposite side of the head, when injuries of the brain from *contre-coup* may be suspected. Though the temperature is variable if the whole course of the disease is considered, yet at an early period (the initial stage) there is a pretty constant elevation. The rectal temperature is a much surer test than the axillary or oral, and whenever possible ought to be taken in such cases. The pulse is generally quick in the early stages. The patient loses his appetite, and becomes fretful, sleepless, and hyperæsthetic to external impressions, such as light and sound. At the commencement the pupils are more or less contracted, though they are sensitive to light; occasionally slightly so.

At a later period, occurring immediately after the symptoms just described, or after a variable interval, during which the patient may even seem to improve, another series of symptoms sets in. The patient becomes drowsy, and soon exceedingly so, perhaps answering questions quite correctly, though with a dreamy, hazy aspect, or accompanied by a meaningless smile, and immediately thereafter passing into a profound sleep. The face is pale and earthy; sickness, accompanied by vomiting, is frequent. Twitchings of the muscles or even convulsions are present, which may point to the special part of the brain affected. These convulsions may be followed by paralysis of the affected muscles. Delirium is frequent at this period. The pulse and the temperature often undergo a marked and characteristic change. The pulse, which at the onset of the symptoms was quicker than usual, now becomes slow, often markedly so. In one case under the writer's care—a girl aged fifteen years of age—the pulse was not more than 40 per minute, with an occasional intermission. The temperature is likewise subnormal, 97° F. or even lower. The decrease in the temperature must not be mistaken for a sign of recovery.

These symptoms are generally succeeded by a very short stage, in which (it may be within a few hours) the temperature and pulse go up with a bound, the former to 104° F. or higher, the latter to 130 or more; the face becomes flushed, the pupils dilated, the sphincters relaxed, the patient comatose, and death rapidly ensues.

In some cases localised pain may be discerned on tapping over the seat of injury or disease. This requires to be done in a systematic manner, one part being compared with another. In others, the application of cold and heat, alternately, may reveal a tender spot, which sometimes corresponds to the seat of lesion.

ABSCESS OF THE BRAIN.—In abscess of the brain, the above symptoms may be the only ones present. In other instances there may be, in addition, vomiting, succeeded after a variable interval by shivering. Short of a distinct rigor, the patient often feels and acts as if he were cold. Twitchings, convulsions, or paralysis may ensue, and if these are isolated they indicate the area principally affected. Though surrounding such spots, diffuse encephalitis may be found. When abscess forms in the cerebral substance the membranes are prone to be affected, and occasionally, when the inflammation has been very acute, sloughs have formed in the dural covering. It is, however, much more likely that the dura mater has been perforated by molecular disintegration, owing to the ulcerative process set up by the extension of the walls of the abscess. Cerebral abscesses have burst and the contents have found their way through the external auditory meatus, or through the cribriform plate of the ethmoid. But it is questionable whether, in these cases, the pus was not extra-dural. The time when abscesses may be expected to form, after an injury to the head, is variable. They have been seen on the fifth day, most likely in such cases originating in a contused cerebral area. When arising from injury to the skull with suppuration of the bone, brain-abscess may be looked for two or three weeks subsequently. From caries of the petrous bone it may arise at any period, the patients being liable to abscess-formation as long as the caries exists. All lesions of the bones of the skull, whether traumatic or idiopathic, are much more prone to induce abscess in the brain when the parts so affected are permitted to become septic. From the nose, the orbit, the antrum of Highmore, inflammatory products have been transmitted to the brain, causing abscess. Disease in the middle ear and caries of the mastoid are apt to set up suppuration in the mastoid cells. As a rule, in such cases the membrana tympani is perforated, and a purulent discharge escapes. When suppuration is set up in the mastoid cells there is generally pain or tenderness behind the ear, and sometimes this is followed by redness and swelling. Headache is constant, and cerebral disturbance frequent. Twitchings or paralysis of the facial muscles, arising from irritation or compression of the facial nerve, frequently occur.

The symptoms characteristic of encephalitis ensue on extension of the inflammatory action inwards. It must be borne in mind that abscess of the temporal lobe may attain considerable dimensions without inducing localising symptoms; this part of the brain, not containing any direct motor tracts, and there being no case on record of disease of the cortex of the temporo-sphenoidal lobe having given rise to deafness. In such cases symptoms of compression are present, and if these are taken in conjunction with the existence of otorrhœa, and especially if they occur in children, a probable localisation in the temporal lobe may be made. When the base of the lenticular nucleus is involved, causing compression of the internal capsule, various sensory disturbances may be induced, along with partial hemiplegia. Compression of the cerebral peduncle is sometimes found in such cases, as evidenced by paralysis of the oculo-motor nerve. The discharge from the ear frequently ceases shortly before the onset of severe symptoms. This may be accounted for by the swelling of the lining membrane, and, owing to the discharge not finding exit, the disease is apt to spread through the thin lamina separating the mastoid cells from the dura mater. The inflammatory action may also spread along the veins. The most constant of the emissary veins runs through the mastoid foramen, and connects the lateral sinus with the posterior auricular vein or with the occipital. It has been averred that inflammation of each portion of the ear is transmitted to a particular region of the brain. Thus inflammation of the external auditory meatus is said to induce suppurative inflammation in the cerebellum and in the lateral sinus; inflammation of the cavity of the tympanum to give rise to abscess in the cerebrum; and inflammation of the labyrinth to produce inflammation of the medulla oblongata. There are not sufficient data to warrant a definite conclusion on these points. It is true that abscesses of the brain arising from affections of the ear are found most frequently in the hemispheres, occasionally in the cerebellum, and rarely in the pons. When disease of the mastoid cells occurs in early life, abscess is most prone to affect the cerebrum; when it arises late in life the cerebellum is most apt to be the seat of disease.

The differential diagnosis between meningitis and encephalitis is in many instances difficult and in others quite impossible. Some information may be derived from the date of the appearance of the symptoms after the accident. When inflammation arises from punctiform ecchymoses and intense congestion following severe brain-shaking, as in some forms of concussion, the symptoms appear very early —within the first forty-eight hours. In contusion of the brain, especially when localised, the inflammatory symptoms manifest themselves in four to seven days after the injury; whereas in inflammation spreading from injury of the bone to the membranes, it generally does not manifest itself till a much later period, often weeks after the accident. But though this periodicity existing between the injury and the appearance of the cerebral symptoms does frequently occur, it cannot be implicitly relied on as a differential sign. Thus the writer has seen a case of compound fracture of the skull, giving rise to meningitis—as evidenced by symptoms—on the second day, and proving fatal within the first four days after the injury. A diagnosis may be made with greater probability between meningitis and encephalitis by ascertaining whether there are any external signs suggestive of the former. If there be a contusion of the scalp without a wound, one ought to ascertain the state of the bone underneath by making an aseptic incision on the appearance of inflammatory symptoms. If the bone be found bare, much contused, fractured, or otherwise injured, it is probable that the inflammatory symptoms are due to meningitis beginning in the dura mater. If any of these injuries are associated with wounds, they may then more readily give rise to meningitis. But if the wound is not aseptic, there is a probability of cerebral inflammation due to infective infiltration or pyæmia; and if the symptoms occur a week or longer after an injury there is reason to fear the presence of this serious affection.

Treatment.—The patient ought first to be thoroughly examined. Besides investigating the functions of the brain, those of the other viscera, especially the kidneys, should receive careful attention, as by so doing symptoms which otherwise might be obscure may be at once traced to their source and treated intelligently. If there be a wound it ought to be scrupulously attended to, the most rigid antiseptics being employed. The temperature ought to be carefully watched throughout, as it is a valuable guide to the patient's condition, a rise often heralding serious changes, such as convulsions. The patient ought to be kept in a quiet room and in a subdued light. In all cases the head may be shaven with advantage, as it relieves the headache, at least temporarily, and facilitates after-treatment. The head may be kept a little higher than usual, but this may be regulated according to the patient's desire. During the whole course of the disease the food ought to be of the lightest and simplest description, milk being probably the best. The bowels ought to be carefully regulated throughout; free purgation is one of the most important points, especially in the early part of the disease, the symptoms being often relieved by the administration of a brisk purge. For this purpose mercurial preparations, especially calomel, are very valuable, some ascribing to them a special action over and above their purgative property. Those who advocate this special action advise that they should be pushed until the gums are touched. Many, however, believe that salivation is quite unnecessary, and with them the writer agrees. Croton oil is of great service in such cases, more especially when there is inability to swallow or insensibility, rendering the administration of other medicines difficult. One or two drops should be placed on the handle of a spoon and rubbed on the back of the tongue; or, if the patient can swallow, the oil may be given in sugar or other vehicle. Enemata also are of service as an aid to the purge. Then there are certain remedies the efficacy of which in such cases may be considered doubtful. These are stimulants, opium, blisters, the application of cold, and blood-letting.

Stimulants, if ever required, which may be doubted, ought to be given with the greatest circumspection. They are very apt to do harm. Opium has been advocated in certain delirious conditions ensuing in encephalitis. It tends to the production of internal congestions, and therefore ought to be avoided. Bromide of potassium, or even chloral, may be substituted when medicines of this kind are required; but the exhibition of such drugs is apt to obscure the symptoms, and that at a period when time is of great value. Blisters ought not to be resorted to in the acute stage. They are of service, however, in chronic encephalitis. It has been advised to place them over the nape of the neck. When applied in this position, the raw surface which is left is very apt to become irritated from friction, owing to the restlessness of the patient. It is, on the whole, better to put the blister on the vertex, and it is equally efficacious. The application of cold to the head is highly lauded. It may be applied in several ways, such as by evaporating lotions, by ice enclosed in bladders or in india-rubber hoods, or by a continuous current of water passing through a bag or coil of tubing. Evaporating lotions are often soothing to the patient, and are not likely to do harm. Ice applied to the head in bags is uncomfortable, and is frequently a source of great annoyance to the patient, both from its hardness and the frequency with which it has to be changed.

The best form of applying cold to the head is by some apparatus through which a constant current of water is passed, cold being substituted for that which has been slightly heated by contact with the layer next the surface of the head. For this purpose Dr. Robertson's water-bags are very suitable. They are made of thin india-rubber with an afferent and efferent tube attached to opposite corners. The former of these is inserted into a basin containing cold water, which may be iced if wished, and the current is established and maintained by syphon action. Leiter's tubes, of flexible metal, have subsequently come into use, and they answer the same purpose. When neither of these is at hand, the practitioner may substitute for the latter a piece of india-rubber gas-tubing, which may be formed into a coil and applied to the head. As these are usually lined with spiral wire, they do not collapse under the weight of the head. A string may be tied to one extremity of the tube to regulate the outflow by diminishing its calibre. Cold applied in any of these ways undoubtedly causes a contraction of the vessels of the scalp; but is it sufficient to produce the same action in the interior of the brain, and, if not, does the contraction of the superficial vessels not induce a greater turgescence in the interior of the brain? When one considers the large quantity of blood which is passing through the brain, it must be apparent that the local application of cold to the surface cannot have much effect on the deeper structures.

The employment of blood-letting in the early stage of brain-inflammation is almost obsolete, though some surgeons still believe in its value when judiciously used.

Treatment of intracranial suppuration.—Whenever the inflammation has passed into an acute stage, the surgeon should be prepared for the advent of suppuration. This may be indicated by symptoms of compression, convulsions, paralysis, &c., the careful observation of which may lead to localisation of the affection, this being the principal step toward establishing a correct treatment. If there is a wound leading to bare bone, or superficial signs of local injury or the existence of Pott's puffy tumour, it would be right to make out whether there is suppuration under the skull at that part by elevating the bone. But suppose the indications afforded by convulsive movements, by paralysis, or otherwise, should indicate that another brain-area is involved, which should the surgeon prefer as a guide: the superficial appearance of injury, or the motor or sensory signs, pointing to a lesion situated elsewhere in the brain? If the latter are distinct and show a precise localisation, they are much to be preferred. The writer has had cases illustrating this. One of them is as follows: A lad was seen by him suffering from cerebral abscess, with symptoms pointing to a localisation in the base of the third frontal convolution, but with a superficial lesion situated in front of the brow. The abscess was found in Broca's lobe, and not near the point of bare bone, which was the seat of injury. Other cases of even more pronounced character have been seen, where the traumatism apparent on the surface did not guide to the area of cerebral compression, which, however, was marked by motor symptoms, pointing to another region. These would lead one to the conclusion that motor symptoms, when sufficiently pronounced, are more to be relied on than the mere appearance of injury on the external surface of the scalp as indicating the seat of the cortical lesion. When, however, such external indications are combined with symptoms localising the lesion at the same spot, the diagnosis is rendered the more certain. It must be borne in mind, in the absence of localising symptoms, that the brain may be injured at a part opposite to that of the external injury, arising in such cases from *contre-coup*.

Regarding the localisation of the lesion, twitchings and convulsions are of great service, especially when confined to a particular set of muscles, or to one limb, or even to both limbs of one side. But inasmuch as many convulsions, though at first limited and following a definite order, soon become general, and thereby their distinctiveness as motor localising elements is lost, it is necessary to have the onset of the convulsions closely watched. It will be fortunate if the surgeon can see the onset of these attacks himself. But he cannot always be with his patient, and if he leaves, even for a short period, a seizure may take place in his absence, and its valuable indications be lost. Under such circumstances, is there no method whereby these convulsions might be watched, or data from which their advent might be expected? Accurate thermometric observations will frequently give a forewarning of the approach of convulsions, as indicated by an acute rise in the temperature within a comparatively short time. An intelligent nurse, trained to watch such cases, and whose word can be implicitly relied on, is invaluable, not only in carrying out the treatment, but as an instrument of observation. She ought to be instructed to record the temperature every two hours, and she ought to be prepared to note down the order in which the particular parts of the body twitch or become convulsed. On any sudden increase of the temperature the surgeon should be at once apprised of it, so that he may be able to be present at the beginning of convulsive movements.

Suppose that the abscess be traced to a particular locality of the brain, is it to be left alone, or are its contents to be allowed to escape? If the surgeon has the ordinary antiseptic means at his disposal, he ought to evacuate the contents of the abscess as soon as its locality is clearly recognised. For this purpose the skull ought to be opened. Before doing so the head ought to be freshly shaven. The skin should be washed with soap and water—a flesh-brush being used. It should then be cleansed with turpentine to remove any greasy matter, and finally with the antiseptic which is to be employed during the operation. In such cases the writer has always operated under a carbolised spray, and the whole operation has been at all times carried out under antiseptic precautions. The bone may be elevated in several ways. Some have advised the use of a mallet and chisel—a most objectionable practice. Others saw a triangular or rectangular portion of bone, which they then elevate, leaving it attached to the soft parts at one side, which act as a hinge, and enable the bone to be folded back. The writer has used this method on two occasions. It is suitable for cases where a large portion of the brain has to be brought into view. It, however, takes longer than trephining, and is not free from other disadvantages.

Trephining—the removal of a disc of bone by a cylindrical steel saw—is the easiest method of removing bone from the skull. The surgeon should be in possession of crowns of various sizes, which he may use as the case requires. For exploratory purposes, and especially when he believes there is pus located between the dura mater and the bone, a disc mounted in a drill-handle, and measuring not more than one quarter of an inch in diameter, is very serviceable. A small aperture is made by this means, which may be readily filled up, and through which a meningeal abscess may be evacuated. But when the abscess is situated in the brain, a large disc of bone ought to be removed. The ordinary trephine used in this country is imperfect. An instrument of the nature of the French trepan is much preferable. Sinuses must be avoided. When a sinus has been opened by mistake, a plug of catgut may be introduced. Firm digital pressure on the walls of the sinus against the bone for five consecutive minutes has been in one instance effective in stopping the flow. When the dura mater has been exposed, if the abscess is superficial the dural membrane bulges into the aperture in the skull, and there will be no cerebral pulsations visible. Occasionally the dura mater will be found to be already perforated by ulcerative action, and then the matter will ooze out or well away as soon as the disc is removed. But if this has not taken place, the membranes should be opened with a sharp bistoury. The pia mater, if inflamed, will be softened, and be of a dull leaden hue, and probably adherent to the cortical substance as well as to the external coverings.

Provided the localisation has been clearly made out, and the abscess is seated in the white matter, an incision ought to be made into it. Occasionally the brain-tissue in the vicinity of the abscess is softened to such an extent that the substance immediately fills up the incision made with the thin-bladed bistoury, so that the escape of pus is hindered. Most frequently the pent-up pus escapes with ease. A hollow needle might be employed when the abscess is deeply seated, as the pus might drain slowly through it. After the evacuation, the aperture ought to be carefully dressed, free drainage being established, the head being kept in the best position for that purpose. Subsequently the head should be dressed only when the temperature gives indications of mischief, or when the dressings show the slightest stain. The patient ought to be carefully attended to, the bowels kept regular, and the diet low. He should be kept quietly at rest in bed until the wound has thoroughly healed. He ought not to be allowed to move about sooner than a month under any circumstances. Any precipitancy in allowing the patient to go about, or any excess in diet, may lead to serious consequences.

William Macewen.

ENCEPHALOCELE. *See* Meningocele.

ENCEPHALOID CANCER. *See* Carcinoma.

ENCHONDROMA.-When non-malignant, this class of tumour is composed of cartilage only, or, if mixed with fibrous tissue, mainly of cartilage. Cartilaginous tumours, when originating in bones, which are their principal seats, are found either as central growths or—much more frequently—as outgrowths; and in this latter form the tumour may be either single—in which case the part involved is usually near the end of one of the larger long bones—or multiple, when the smaller long bones of the hand or foot are affected.

Tumours consisting largely of cartilage occur occasionally in the testis, in the tumours connected with the salivary glands—notably those of the parotid—in lymphatic-gland and connective-tissue tumours.

Cause.—Seeing that so many of the multiple enchondromata are found growing in young patients, or can be traced back as having commenced in early life, it seems probable that the cause of these tumours is to be found in errors of development, of the nature either of over-production, or rather of an irregular overgrowth of the rudimentary cartilage-elements. Of those tumours which occur later in life, either as single tumours around a long bone or mixed with other tissues in glandular growths, no special cause can be given.

Pathology.—In minute structure cartilaginous tumours may be said to correspond almost exactly with fœtal cartilage, consisting of stellate cells embedded in a hyaline matrix. Single tumours affecting the ends of the long bones grow to an enormous size, yet but seldom invade the contiguous joint. In the area of their bases of attachment to the bone they are prone to ossification, and in other parts to undergo cystic degeneration, well-defined spaces being formed, filled with a viscid mucoid fluid. In the multiple enchondromata, on the other hand, growth seems after a time to be arrested, and, beyond the inconvenience or disfigurement, they cease to cause anxiety. The central tumours are encapsuled, and are surrounded by a wall of compact bony tissue.

A feature in the pathology of some enchondromata which is peculiar to these amongst the tumours regarded as non-malignant, is the fact that occasionally dissemination occurs, nodules and even large secondary growths being found both in the lymphatics and in the internal organs, which have in this way destroyed the patient's life.

Diagnosis.—In the cases of multiple enchondromata, or of the single ones about the hand, the diagnosis is simple, as there is no other form of tumour with which they could be confounded, being less hard than bone, and yielding often, upon firm pressure, a 'crunching' sensation, which, when it can be obtained, forms conclusive evidence of a tumour being cartilaginous; when pedunculated they can be made to rock. The larger single enchondromata require to be distinguished from those sarcomata which may be either ossifying or chondrifying, or undergoing both of these changes; but sarcomata of this type are more prone to occur in the pelvis and bones of the trunk, whilst the periosteal sarcomata, that are found in the situations which enchondroma usually occupies, are soft and smooth on the surface and of rapid growth, cartilaginous tumours being usually of much slower growth, as well as being hard and nodulated.

Between a central cartilaginous tumour and a central sarcoma or a myeloid tumour a diagnosis cannot always be made. Of course, if the characteristic yielding sensation of cartilage can be obtained, the case is clear, but, failing this sign, the diagnosis rests upon the probabilities of age, duration, rapidity of increase, pain, and invasion of health. When cartilage enters into the composition of a glandular tumour the hardness and nodulated character of the tumour commonly render the fact evident.

Treatment.—Amputation of a finger or even of part of the hand may be necessary to relieve a patient of a member which, from the size an enchondroma has reached, has become a useless incumbrance; but we cannot say this procedure is required on account of the nature of the growth itself. So also eventually is amputation necessary when enchondroma of a large long bone has reached a size which puts a stop to locomotion or threatens life. For central cartilaginous tumours in bone the attempt should be made to enucleate the growth, and this will generally prove feasible, unless the surrounding bone has been reduced to a mere shell. A. Willett.

ENDOSCOPE.—The endoscope is an instrument designed for the direct exploration of internal organs and cavities by the sight. There is no portion of the human body, into which a straight tube can be introduced, in which it may not be employed profitably. By its aid we can examine the urethra, bladder, rectum, uterus, nasal fossæ, pharynx, larynx, external meatus auditorius, wounds, cavities of abscesses, and so forth. In its most perfect form curved tubes may be used as endoscopic specula.

This instrument, which is one of the numerous modern adjuncts to physical diagnosis, dates back to the early part of the present century, when we find Bozzini of Frankfort, in 1806, using his 'light conductor.' In 1824, Dr. J. D. Fisher, of Boston, devised an instrument not unlike that in use at present, and shortly after, Segalas, of Strasbourg, followed his example. Later on, Bombalgini, Avery of London, and Hacken of Riga, added their labours and experiences, thus far, unfortunately, unprofitable.

In the year 1865, Desormeaux, of Paris, published his remarkable essay on the subject of endoscopy, and from that date to the present time this mode of exploration has been used more frequently, scientifically, and fruitfully than before.

It will be right here to define what may be fairly considered the real value of the endoscope as a means of diagnosis and treatment. The writer holds that it is not an instrument needed for general use, but rather one for employment in cases of exceptional obscurity, in which its help will be found to make all the difference between blundering guesswork and absolute certainty.

The following may be taken as a general description of the instrument.

In the first place there is a tube or speculum, which is introduced into the canal or cavity to be examined; and at one extremity of this a mirror of polished silver, perforated in the centre, is placed at an angle of 45 degrees. The function of the mirror is to reflect the light, which is placed laterally, into the tube, so as to illuminate it to the end. As the calibre of the tube is usually very small, a most brilliant light is required, and, in order to obtain the best effects, it should be made to converge slightly upon the mirror. This convergence is obtained by interposing between the light and the mirror a plano-convex lens of suitable focal length.

The light being sufficient, the lens properly adjusted, the mirror bright, and correctly placed with respect to the speculum tube, it becomes a matter of facility for the eye of the observer, looking through the aperture in the mirror, to see clearly to the bottom of the speculum, and recognise whatever may lie there. Various specula are required for endoscopy. The urethral tube is the most generally useful, but special ones are needed for the examination of the bladder, rectum, nasal fossæ, auditory meatus, &c.

Various lights have been tried for obtaining the needful illumination—sunlight, ordinary daylight, the Drummond, magnesium, and electric lights. As a rule they are toys in endoscopy, and not practically useful. Desormeaux uses a gazogene lamp of minute dimensions, which gives a very insufficient view. After numerous and prolonged experiments the present writer has arrived at the conclusion that nothing equals, for the purpose, the intense light derived from the thin edge of the flat flame of a small paraffine lamp.

Before concluding, a few examples of the value of endoscopy, *in cases of obscurity*, may be here cited.

Case I. In the autumn of 1865, Dr. S. consulted the writer, by letter, relative to extreme irritability of the bladder, from which he had suffered for six months, and for which he had taken, in vain, the advice of two very eminent London surgeons, one of them a specialist of the highest skill in diseases of the urinary organs.

Dr. S. came to Dublin for examination, when the writer found him a hale man of about sixty years of age, in good health except for the irritable bladder, which necessitated his passing water every ten minutes, and totally disabled him from performing the duties of his profession. The urine exhibited, after standing some hours, a very slight deposit of muco-pus; otherwise it was healthy, of good specific gravity, acid reaction, and containing no greater amount of albumen than was accounted for by the minute quantity of muco-pus.

With the assistance of Dr. Robert MacDonnell the writer made a careful endoscopic examination of Dr. S. The urethra and bladder were found healthy, with the exception of a small patch of superficial ulceration, or rather abrasion of the mucous membrane, in the site of the trigone. This lesion explained the whole case. The moment the urine reached this spot the irritation began, and could not be assuaged except by emptying the bladder. The indication for treatment obviously was to heal up this abraded surface.

Local measures being far more likely to attain that end than drugs, an instrument was constructed (a canula open on the curved aspect) with which the writer easily conveyed a watery solution of nitrate of silver to the part (gr. x.–f ʒj). A few applications dulled the sensibility, and made Dr. S. more comfortable, and after a time he was allowed to return home, and directed a daily injection of the bladder (previously emptied) with a solution of nitrate of silver, (gr. j.–f ʒj). The case progressed steadily, and in four months a perfect and permanent cure was effected.

Case II. In the year 1866, the late Dr. Fleetwood Churchill, senior, asked the writer to examine a young lady who suffered from an extraordinary irritability of the bladder. Dr. Churchill had ascertained that there was no stone, and that the urine was perfectly normal. An endoscopic examination of the bladder demonstrated its perfect healthiness, the whole surface presenting the mamillated rose-red surface familiar to the trained endoscopist. The absence of bladder-disease led the writer to suggest an intra-uterine examination, which showed a closely contracted cervix, with diseased lining membrane.

To facilitate further investigation Dr. Churchill dilated the cervix with the sea-tangle bougie, and from that time the irritability of the bladder disappeared. In this case the perfect healthiness of the bladder, proved by the endoscope, suggested the reflex origin of the symptoms, and treatment of the uterine disease effected an immediate and permanent cure.

Case III. Mr. R., aged about forty years, had long suffered from rectal hæmorrhage, which latterly threatened to undermine his health. He had become markedly anæmic, breathless on exertion, and lost all appetite. Careful examination of the rectum with the ordinary speculum had already failed to discover the cause of the bleeding.

An endoscopic examination cleared up the difficulty, and enabled the writer, and Dr. Tegart, to see a bleeding growth, situated so high up in the bowel as to be beyond the reach of the ordinary speculum. Mr. R. was conveyed to Dublin, and on the 11th of April, 1876, assisted by Dr. Tegart and Dr. P. Hayes, the writer succeeded, with great difficulty, owing to its unusual position, in ligaturing the vascular tumour. The result was a perfect cure of the hæmorrhage, and in a few months Mr. R. completely regained his health and condition.

The three foregoing cases have been selected from amongst many, to illustrate the help which may be gained by the use of the endoscope, towards precise diagnosis and effectual treatment, in certain obscure ailments of the bladder, uterus, and rectum.

F. R. Cruise.

ENTERECTOMY, or excision of a part of the small intestine, has been performed for the relief and cure of the following conditions:—Simple and epitheliomatous strictures of the small intestine; occlusion of the bowel by adhesion and matting of the coils, of such a character that the deviation of the gut cannot be corrected; obstruction by non-carcinomatous neoplasms; gangrene due to the various forms of strangulation and to hernia; irreducible or gangrenous intussusceptions, and for the closure of fæcal fistula.

It will be seen that under certain of these circumstances the operation not only serves to remove the obstruction, but to cure the condition which produced it. In certain of the conditions named, such as in the various forms of stricture, in obstruction by large tumours, and in irreducible intussusceptions, the operation offers the only chance of cure, while other measures short of resection can only bring about a temporary relief.

There are two different methods of performing the operation. In the one the diseased segment is excised, the divided ends of the bowel are then at once united by sutures, the parts so adjusted are reduced into the abdominal cavity, and the wound in the parietes is closed. In the other, after the resection has been performed, the divided ends of the bowel are stitched to the margins of the wound in the parietes, and an artificial anus is established. After a certain interval, the artificial anus is closed by a second resection operation with immediate suture, or by some of the other measures available for the treatment of such abnormal apertures.

1. In the first mode of procedure the abdomen is opened by an incision in the linea alba below the umbilicus. The portion of gut to be resected is drawn out of the wound. The wound is then plugged round about the gut by means of warm carbolised sponges, so that, should the intestinal contents escape during the operation, they may not find their way into the peritoneal cavity. The bowel must now be occluded both above and below the part that is to be excised. This can be accomplished either by the fingers of an assistant, or by means of the various clamps invented for the purpose (Rydygier's, Bishop's, Makins', or the writer's). The portion of gut is now to be excised with scissors, and a triangular piece of the mesentery resected, the base of the triangle corresponding to the segment of bowel removed. The divided mesenteric vessels are secured, and the cut edges of the mesentery approximated by several points of suture. The divided ends of the bowel are now approximated and united by sutures. A number of sutures are first to be applied so as to unite the edges of the mucous membrane, that membrane being freely exposed by the retraction of the muscular coat. An outer line of sutures is then applied so as to bring the serous surfaces of the two pieces of gut into close contact. The best suture for this purpose is that known as Lembert's. In all, some 40 points of suture are required, 15 for the inner row and 25 for the outer. The best material for the purpose is the finest Chinese twist, and the needle used should be very fine, round on section, and so curved as to form half a circle. Hagedorn's needles are very well suited for the purpose. The clamps are removed, the bowel is returned into the abdomen, and the wound in the parietes is closed. After the operation the patient must be kept well under the influence of opium, so as to insure the absence of movement in the bowel. The patient may have ice to suck, but no food should be given by the mouth for at least three days, and then it should be given in small quantities, and in a fluid form. If necessary the patient's strength may be supported by enemata of brandy and peptonised beef-tea. Such enemata are, however, contraindicated if they induce undue peristaltic movements.

2. In the second mode of procedure, a portion of intestine and a triangular piece of the mesentery are excised, as in the method just described. The gap in the mesentery is united by a few points of suture, and the divided ends of the intestine are so adjusted to the margins of the wound as to establish an artificial anus. This fistula is subsequently closed by a second resection operation, followed by suturing of the divided ends and closure of the abdominal wound. Or it may be closed by any other of the measures applicable to the cure of Artificial Anus.

There is no doubt that in cases of intestinal obstruction the second operation is infinitely preferable to the first, and should be the procedure selected in such cases. It must be borne in mind that the patients' lives are threatened by reason of the obstruction, and it will be seen that the latter of the two procedures detailed above will give the most ready and complete relief. The sutured bowel, when returned into the abdomen, lies as a paralysed loop, and may well help to maintain already existing symptoms of obstruction. Besides, patients upon whom these operations are performed, are often in a critical condition, and not in a state to bear well so prolonged an operation as is the first-named. Moreover, to prevent fæcal extravasation at the suture line, the bowel should be as nearly as possible empty and in a fairly healthy condition. When the first-named of the two procedures is adopted in a case where obstruction exists, the operation is performed upon a bowel in a state of considerable distension, and upon tissues that are apt to be congested and inflamed, if not even on the verge of gangrene. The general mortality of resection operations is 50 per cent. Frederick Treves.

ENTEROCELE. *See* Hernia, Strangulated.

ENTEROTOME, Dupuytren's. *See* Artificial Anus.

ENTEROTOMY. — This procedure, sometimes known as Nélaton's operation, consists in establishing an artificial anus in the small intestine. The seat of the operation is the inguinal region, preference being given to the right side. An incision is made through the abdominal parietes parallel to, and from one inch to one inch and a half above, Poupart's ligament, and to the outer side of the deep epigastric artery. The incision is carried through the external and internal oblique and the transversalis muscles, and the peritoneum is divided. The skin incision should be about three inches long, but the deep incision, whereby the peritoneum is opened, need be no more than about one and a half inches in length. The abdominal cavity having been opened, the first *distended* coil of bowel that presents itself is gently seized and drawn into the wound. The gut is then fixed to the wound by a double line of sutures, which are applied in a row, one on either side of the skin incision, and which transfix the intestinal walls. An opening is finally made into the bowel between the two lines of suture, and the operation is completed. When enterotomy is performed upon the right side, as is usually the case, the part of the intestine opened is nearly always the terminal portion of the ileum.

This operation has been done for almost every form of intestinal obstruction. It affords relief, but it cannot become a means of cure since it leaves the cause of the obstruction untouched. If destructive changes are taking place at the seat of the obstruction at the time when the enterotomy is practised, they will continue to progress in spite of the procedure. The operation is performed in the dark, and is to a great extent independent of diagnosis. In several instances an artificial anus has been established in the ileum to relieve an obstruction which a subsequent autopsy showed to be situate in the sigmoid flexure. If it should so happen that a loop of jejunum is opened instead of ileum, death from marasmus will in time attend the establishment of a fistula so near the stomach. In any case much distress is apt to be caused by the accumulation of fæces between the fæcal fistula and the seat of the obstruction. There are certain cases however—as for example when obstruction depends upon the extensive matting together of coils of intestine—in which enterotomy offers the only means of saving the patient's life. Mortality:—Out of 61 recorded examples of enterotomy for non-malignant forms of obstruction, 20 are described as cured, while 41 died. Out of 48 examples of enterotomy for malignant stricture of the bowel, 6 are described as cured, while 42 died.

Frederick Treves.

ENTROPION.—The edges of the lids are more or less inverted, so that the lashes are turned towards the eyeball. The lashes themselves may be regular, or they may be irregular, as in trichiasis. *See* Eyelids. The inversion may be complete or it may be partial, and in either case it may be acute (spasmodic) or chronic (inflammatory).

Acute Entropion chiefly affects the lower lid, especially in old people (senile entropion). From the shrinking of the tissues in old age the globe recedes somewhat into the orbit, the lower lid loses support, and is turned inwards by the action of the marginal fibres of the orbicularis muscle. This is especially apt to occur when the eyes are bandaged. It not infrequently happens in old persons operated on for cataract that, when the eyes come to be tied up after operation, the lower lid becomes inverted, though previously there had been no inversion. Acute entropion may, however, occur in younger persons from injury or inflammation of the conjunctiva or cornea. In any case, the irritation of the lashes in entropion may set up inflammation and even ulceration of the conjunctiva or of the cornea. From the displacement of the lacrymal puncta there is a constant overflow of tears, which may lead to excoriation and inflammation of the edges of the lids.

Treatment.—In slight and temporary spasmodic entropion it may be enough to draw the edge of the lid outwards from time to time, or to fix it with collodion or strapping. In order to facilitate the drainage of the tears the lower canaliculus should be opened. Should these simple measures fail, an elliptical fold of skin may be excised from the outer surface of the lid and close to the margin. The size of the piece of skin will depend upon the amount of inversion and the length of time that it has lasted. After removal of the skin a strip of the most marginal fibres of the orbicularis may also be removed. Sutures may be applied, or not. In order to increase the effect of the operation, a snip, one-eighth of an inch deep, may be made on the edge of the lid close to the external angle. This divides those marginal fibres of the orbicularis muscle which are chiefly instrumental in producing the inversion. Many other procedures may be resorted to, as subcutaneous sutures, canthoplasty, or division of the external canthus, Graefe's operation, &c.

Chronic Entropion.—In this form the edges of the lids are often thickened and red, and there is usually some trichiasis. The skin is not lax, as in the acute form, and the tarsus itself is generally incurved. There may be also contraction of the palpebral aperture (blepharophimosis), together with signs of chronic, especially trachomatous, conjunctivitis. The result of chronic inversion is irritation of the conjunctiva and the cornea, or even inflammation and ulceration of the cornea, with lacrymation and dread of light. Owing to the displacement of the lacrymal puncta there is epiphora. It may be the result of inflammations, or it may be traumatic and due to burns, especially with lime or ammonia. In extreme cases the conjunctival sac may be obliterated.

Treatment.—Canthoplasty may be done if the palpebral aperture be shortened; excision of an elliptically-shaped piece of skin, if there be no incurvation of the tarsus; but if the tarsus be incurved, as after trachoma, the operative procedure must be applied to the tarsus. Two methods are in use: one consisting of removing a V-shaped strip from the *outer* surface of the cartilage near the edge, 'grooving the fibro-cartilage' (Streatfeild-Snellen), the other consisting of making an incision through the tarsus from the *inner* side near the margin, and throughout its entire length (Bürow). The principle of the former is to correct the deformity by shortening the outer surface; that of the latter, lengthening the contracted inner surface. Another operation consists in splitting the margin of the lid throughout its entire length immediately within the row of eyelashes (Arlt). This procedure is especially indicated when the conjunctiva is greatly contracted. Each of the plans above mentioned attempts to retain the eyelashes; but in some instances it may be necessary to excise the lashes. J. Tweedy.

ENURESIS. *See* Incontinence of Urine.

EPHELIS. *See* Lentigo.

EPIDIDYMITIS. *See* Testis, Diseases of the.

EPIPHORA. *See* Lacrymal Apparatus, Diseases of the.

EPIPHYSES, Affections of.—These may be acute or chronic in their course, central or peripheral as regards their starting-point. They are essentially affections of infancy and childhood, though of course they may occur up to the age when the epiphyses unite with the shafts, which in some cases may be as late as the twenty-first year of life. As a rule, the acuter forms of disease are found among infants, the more chronic among older children; they are rarely primary; or, to speak more definitely, they depend either on some constitutional cachexia or on septicæmia. The diseases which commence at their line of junction with the shaft (peripheral) are more common than those which commence in the interior of the epiphysis (central). The so-called epiphysitis, in many cases is an inflammation along the line of junction with the shaft, and more often due to disease in the shaft than in the epiphysis; the integrity of the latter being shown by the continued growth of the diaphysis, and explained, probably, by the immunity which non-vascular structures enjoy over more vascular ones in early life.

Causes.—By far the commonest cause of the acute affections of the epiphyses is some congenital dyscrasia, especially inherited syphilis. Though much less frequently, acute rickets and scurvy also lead to acute inflammations at or near the epiphysial line, which may be followed or not by disease of the epiphysis. Septicæmia is another cause, and this variety of lesion, usually multiple, is more acute and more destructive than any of the foregoing. In all the forms, injury—traction on joints during parturition, sudden jerks, blows, falls, &c.—is often the more immediate cause. In the chronic forms, injury again plays an important part; occurring in later childhood, the strumous diathesis is often the predisposing factor. In a few cases, even in which there does not appear to be any constitutional dyscrasia, blows or falls set up acute or subacute disease in the ossifying centre of an epiphysis, apparently by detaching it from its connection with the surrounding part, or in consequence of hæmorrhage or of mere concussion; the centre either dies outright, or takes on subinflammatory changes which lead to abscess, or to arthritis.

Pathology.—The pathological anatomy varies within considerable limits, depending on the stage of the disease when examined, or on the acuteness of the process, and a little also on the nature of the initiatory lesion. In all the peripheral affections, at the line of junction with the shaft, and in the soft, most recently formed osseous layers there are hyperæmia and exudation of cells.

The amount will vary in proportion to the acuteness of the process. In congenital syphilis, this exudation may be so abundant as to allow the epiphysis to move freely on the shaft; in some cases the epiphyses appear to be quite separated; suppuration is rare, but sometimes occurs. As a rule this exudation-material is sanguineous, it is contained within the periosteum, and rarely shows any tendency to point externally, the adjoining part of the shaft not rarely participates in the disease; complete recovery may take place under suitable treatment. In acute rickets a very similar condition may exist, but it rarely assumes the same extent; the bones become extremely vascular and softened, so that fracture not infrequently results. In some forms of infantile scurvy also, an acute inflammation of the diaphyses of the long bones occurs, which may compromise the epiphysis. In septicæmia, the shafts of the long bones are often the starting-points of the disease, and the epiphysis becomes secondarily implicated; or, beginning within a joint, disease spreads to the line of junction, thence to the shaft if, as in the hip and shoulder for instance, the epiphysis happens to be within the joint-capsule. In all the foregoing cases the affection is more often multiple, the attacks not necessarily occurring all at once, but in rapid succession; sometimes the chief violence of the disease expends itself on one joint or bone, while the remainder are less profoundly affected.

Under the term 'acute arthritis of infants' Mr. Thomas Smith has described cases which include the septicæmic variety, and—as the writer of this article thinks—other and more distinctly epiphysial conditions, the feature in common being arthritis. In a few cases, epiphysial disease proper may be acute, and lead to arthritis or abscess; it is then mostly in consequence of necrosis or caries in the ossifying centre. But more generally the change is a chronic one, the centre becomes inflamed and caseous, pus forms slowly, and before making its way out, or towards the joint, it gives rise to chronic inflammation and to pulpy thickening of all the soft surrounding tissues. On making a section through such an epiphysis, a cavity is entered, lined with pale, semi-caseous granulation-tissue, and containing what remains of the ossifying centre as a loose sequestrum.

Symptoms.—The symptoms vary as much as the pathological conditions. A pseudo-paralysis of one or more limbs, coming on rather suddenly, attended with pain on handling, with swelling at or near a joint, and occurring in a syphilitic infant, would be almost pathognomonic. A similar condition, occurring in an older child without signs of syphilis, but with the history and evidences of improper hygienic surroundings, would almost as certainly indicate an acute onset of rickets. In young strumous persons, the affected epiphysis excites a little general infiltration of the adjacent soft structures, with a subsequent formation of pus, which is the not infrequent starting-point of joint-disease. In such cases, the acuteness of the process rather modifies the symptoms, and may even mask the disease.

Prognosis.—The syphilitic and rachitic and scorbutic varieties possess unbounded powers of repair under suitable treatment. Where necrosis has actually taken place, the subsequent growth of the limb will almost certainly be impaired: if the diseased epiphysis communicates with a joint, prognosis as regards joint-function must be guarded. In the septic, multiple forms the disease is often fatal both to life and limb.

Treatment.—Generally, for all forms, fixation and rest of the affected limb or limbs are of first importance. Many cases are fatal for want of early recognition of the condition, and as the result of raising the child by its limbs, or of allowing them to dangle as it is turned about; much of the actual separation which takes place is due to lifting or handling the child. In the syphilitic cases, a piece of flannel covered with mercurial ointment should be evenly wrapped round the affected limbs, and over this several turns of soft bandage to act like a splint: this dressing need not be disturbed for two or three days. The limbs should be fully extended and in their normal position; the child must not be carried about, but be allowed to lie on a soft pillow, and be moved as little as possible, or when moved, moved on the pillow. All unnecessary clothes and sleeves should be avoided. Mercurial inunction into the abdomen may be practised simultaneously. Improvement will generally be manifest within a few days; while the low constant cry of pain will probably cease from the moment that immobility of the affected limbs is secured. In rickets or scurvy, evaporating lead lotion made with milk should be substituted for the mercurial ointment, but the same immobility with soft bandages should be secured; cod-liver oil, fresh uncooked pounded meat, fruit-juice, with attention to hygienic details, will effect a marvellous change in a few days. In the chronic cases, an attempt should be made to save the joint. If an abscess point it should be incised freely, and the diseased bone gouged out, if it can be detected with a probe. Not infrequently a central necrosis of the epiphysis will be found; after its removal, the cavity must be scraped out with a sharp spoon, and then filled with some dry absorbent antiseptic wool. Cod-liver oil internally, with change of air to the seaside, are powerful adjuvants in such cases. The secondary affections of joints, if not too far advanced, often subside spontaneously after the exciting cause has been removed; hence the indication is to temporise as long as possible in the hope of restoration without operation. Robert William Parker.

EPIPHYSES, Separation of. *See* Separation of Epiphyses.

EPIPLOCELE. *See* Hernia, Strangulated.

EPISPADIAS. *See* Ectopia Vesicæ.

EPISTAXIS is the term applied to bleeding from the nose, on account of the tendency to 'drip' usually characteristic of the condition.

When *accidental*, the bleeding soon ceases spontaneously in most instances, at any age, especially if resulting from a fall or other blow on the nose, with or without fracture of one of the superior maxillary bones. In rare cases it attends fracture of the base of the skull through the ethmoid bone, as indicated by a subsequent discharge of serous fluid.

Under circumstances of *operation* for the removal of nasal polypus, necrosed bone, or foreign body, the epistaxis may be profuse to a dangerous extent, and require prompt arrest.

In *disease*, epistaxis is apt to accompany malignant nasal tumours, when ulcerated on the mucous surface.

Under other circumstances, *spontaneous* epistaxis varies in severity and danger. In young anæmic persons, or others liable to headache, and in women liable to suppressed menstruation, bleeding from the nose produces relief which more than counterbalances the inconvenience of the flow. Full-blooded persons benefit by a tolerably copious hæmorrhage of this sort; but in middle life and old age it sometimes proves intractable, dangerous, and even fatal.

Treatment.—Whatever be the cause, the arrest of copious or persistent epistaxis should be promptly attempted, except in cases obviously benefited by the occurrence. (1) The first, simplest, only instantaneous means, under all circumstances, at hand, is the adoption of the proper attitude of body. In the standing posture the general vascular tension is at its highest, less in the sitting, and least of all in lying down. In any posture the elevation of the upper limbs, with the hands at their highest, promotes the contraction of the arteries to the head as well as to the lower limb, and instantly arrests epistaxis in many cases. The lying, or at least reclining, posture, and elevation of the arms, should therefore be promptly enforced in the first instance.

Other means may be required, but this is the proper and only sensible thing to begin with, and may be enough if the patient can also be kept still, composed, and reassured. It is not essential that the head should always be kept low, for the head and shoulders can be raised sufficiently for all convenience without departure from the general reclining posture, the attitude of most perfect rest to the heart and blood-vessels.

The next most effectual means are (2) the irrigation of the nose with hot water (*see* Nasal Douche); (3) the subcutaneous injection of ergotin (*see* Ergotin); and (4) plugging the nose, which should never be undertaken unless (2) and (3) have failed. For the last process, both efficiency and comfort have been attained by the use of little bags of india-rubber having a tube attached, and capable, on inflation with air or injection with water, of exercising effectual pressure on the walls of the nasal cavity and arresting the flow of blood. There are two or three varieties of nasal plugs, each of which is introduced, in a collapsed condition, into the nostril, and inflated when *in situ*, with an india-rubber ball, force-pump, or with the mouth. Dr. Wiglesworth's plug is passed behind the posterior nares, inflated, and pulled forwards till the aperture is stopped; the tube is attached to an ordinary plug of lint in the nostril.

The old-fashioned mode of plugging with lint is both difficult, disagreeable, and painful, but as a last resource it has sometimes to be done. A piece of lint, plain or steeped in perchloride of iron, solution or tincture, is folded to fit closely into the posterior nares, to which situation it is drawn through the mouth by a piece of string tied round its middle, and previously passed in at the nostril, round behind the palate, and out at the mouth. This manœuvre is effected with the aid of a urethral catheter, or by a special contrivance called Bellocq's sound, resembling a curved metal catheter, and containing a flexible spring on a stilette, for protrusion into the mouth when the instrument lies in the nose and pharynx.

When the pharyngeal end of the nasal cavity is plugged, the nostril is then plugged with another fold of lint of suitable size, and tied there with the ends of the string attached to the posterior plug, one of which issues from the mouth and the other from the nostril.

The inconveniences and discomfort of this process are so great that it should never be undertaken if it can be dispensed with. RUSHTON PARKER.

EPITHELIOMA. *See* CARCINOMA.

EPULIS. *See* GUMS, Affections of the.

EQUINIA. *See* GLANDERS.

ERECTILE TUMOURS. — These curious swellings, known also under the names of vascular tumours, cirsoid aneurism, arterial varix, teleangeiectasis, and angeioma, may be shortly described as consisting of tortuous vessels or cavernous sinuses freely communicating with each other, and also with greatly enlarged arteries and veins. Occasionally they pulsate, and the skin is often 'stained.' Their customary sites are the scalp and face, often involving the external ear; and at the orifice of the female urethra. Although placed commonly near the surface, the deeper structures are liable to be affected.

Occurring usually in young patients, there are cases recorded of erectile tumours following injuries.

Cause.—The occasional skin-implication denotes their kinship to nævi, and in these instances there exists a common cause suggestive of an embryonic hypertrophy of the capillaries. In the case of the tumours commencing unequivocally in adult life, an hypertrophy due either to an idiopathic or traumatic cause must be the assumed explanation of their origin.

Pathology. — The tumour-like masses consist of a congeries of dilated blood-vessels supplied by numerous arteries, which usually can be traced running into the growth and emptying into large tortuous veins. Their microscopic structure is the same as that of the corpora cavernosa penis. A change, probably of a degenerative kind, is seen in the production of cysts; but the mode in which this is brought about is not clear. Whilst cellular tissue is the structure in which erectile tumours are commonly placed, other structures—notably, the muscles—are liable to be involved in deeply-placed tumours.

Diagnosis.—When placed on the surface, the varicose appearance of the part, its soft sponge-like feel, the subsidence and welling-up again of the swelling, as pressure is either made upon it or relaxed, with the abnormally large arteries in its periphery, unite in rendering a diagnosis easy; but, when deeply placed, the symptoms of aneurism or of a malignant growth may be simulated. The writer has seen the common femoral ligatured for the disease under consideration, the operator believing he was dealing with a case of aneurism of a branch of the profunda. In a patient presenting a tumour aneurismal in character, but not in the course of any arterial trunk, and in whom the health is not affected, nor can any secondary growth be detected, the existence of an erectile tumour is more probable than of either of the others; whilst in cases of pulsating tumours involving bone, the disease will almost certainly prove malignant.

Treatment.—When it can be prudently attempted, complete removal should be performed, as the only really reliable mode of treatment; but if this is, for any cause, unadvisable, electrolysis, steadily persevered with, offers the best prospect of cure. Moreover, it should not be forgotten that these tumours, equally with nævi, may undergo a spontaneous cure, or, at all events, an arrest of growth; whilst, if irritated by ineffectual treatment, they are prone to enlarge. It is well, therefore, to be satisfied that a necessity for interference exists before putting any plan of treatment into action. ALFRED WILLETT.

ERGOTIN, Surgical Use of.—Ergotin is an extract obtained from ergot of rye by a process introduced by M. Bonjean. From a surgical point of view its use as a hæmostatic is that which has mainly to be considered.

M. Bonjean's method of employing it for external use is as follows:—The ergotin is dissolved in five or six parts of water in ordinary cases; in three or four only where the hæmorrhage is severe; and pieces of lint saturated in this solution are applied to the part, previously well-dried, pressure being maintained with the hand until the blood ceases to flow; should the bleeding continue, the lint is kept constantly wet with the solution; the pressure should be firm, but not sufficient to interrupt the circulation. The lint should not be removed for three or four days. Ergotin may also, of course, be administered internally; but all accounts seem to show that this is the most uncertain and least satisfactory way in which it can be used. Hypodermic injection is, beyond question, the best, and therefore the only method which the writer proposes to consider.

Hypodermic injection of ergotin has been practised, and according to reports with a certain amount of success, by Von Langenbeck and some other continental surgeons in the treatment of various disorders or diseases of the vascular system, such as aneurism, varix, hæmorrhoids; and in other tumours where the cutting off or diminution of the blood-supply appeared likely to favour cure. But it is in the treatment of various hæmorrhages that its practical utility has been most certainly demonstrated. In 1874 the writer had the opportunity of trying it in a case of epistaxis which had persisted for more than twenty-four hours, in spite of various remedies, and where plugging of the posterior nares appeared to be demanded. One injection of 3 grains of ergotin acted promptly and permanently. The bleeding had ceased before the writer left the house. Since then he has frequently used or prescribed this treatment in similar cases, and with satisfactory results, except in one instance; and there the cause of failure was no doubt due to an inferior drug, as was proved by the fact that all the injections made from this particular sample proved partial or total failures. In a case of alarming secondary hæmorrhage after the removal of a vascular growth from the base of the tongue, the writer injected 3 grains of ergotin with a like satisfactory result; a second dose was administered within the hour as a matter of precaution; the hæmorrhage never recurred, and the patient recovered. On several occasions the writer has made use of this practice to check free oozing after amputations and excisions, before closing the wound; and in some cases, the effects have been remarkable, resembling those which follow the use of the hot-water douche for the same purpose; the blood became darker, the flow more sluggish, and then in many cases the wound became studded with numerous dark points, no doubt denoting the mouths of capillaries and other small vessels.

Acting on this hint, he has for several years past been in the habit of prescribing a hypodermic injection of ergotin after operations in which, for any reason, oozing or intermediary hæmorrhage seemed likely to occur; always excepting cases where the vessels were atheromatous. To prevent failure, or subsequent inconvenience, two or three cautions may be given. In the first place, the drug should be obtained from a reliable source; for, as previously pointed out, some specimens of ergotin are worthless. Secondly, the risk of subsequent inconvenience, in the form of pain and perhaps inflammation at the site of injection, may be avoided, by thrusting the needle into *muscle*, not merely into the subcutaneous tissue; and, further, it appears advisable that the patient should lie down to receive the injection, for in one or two cases of epistaxis where the ergotin was administered while the patient was sitting up, vertigo or faintness occurred, perhaps from the sudden contraction of cerebral vessels. (It is hardly necessary to point out that the styptic action of ergotin is due to its physiological property of causing contraction in the involuntary unstriped muscular fibres of the middle coat of the blood-vessels.) The dose previously mentioned (3 grains) will in most cases be found sufficient, but may be repeated when necessary; and as this quantity is readily soluble in 10 minims of warm water, the injection is not of formidable bulk. More recently, an alkaloid of ergot (ergotinine) has been obtained, and used with very successful results; an account of which will be found in the Obstetrical Society's *Transactions* for 1882. Chauncy Puzey.

ERYSIPELAS may be defined as a diffused and spreading inflammation of the skin, mucous and serous membranes, or of the connective tissue beneath them; accompanied, and usually preceded by, fever, and due to some poison introduced into the system.

Causes.—A. *Efficient.*—As to the exact nature of the poison, which may be looked upon as really producing the disease, there is considerable difference of opinion. By some it has been believed that there is a distinct and specific erysipelatous virus, similar to the specific miasma of smallpox, scarlet fever, and measles, and that the disease should be classed as belonging to the order of contagious exanthemata. The principal arguments which have been deduced in favour of this hypothesis are, that it is infectious; that it is sometimes epidemic; that the local affection is accompanied by fever; that it has, at all events generally, a period of incubation; that the appearance of the affection of the skin is preceded by an obvious disturbance of the general health, and, lastly, that it runs a more or less definite course. But against this theory is the important fact that erysipelas differs from all other exanthemata in its liability to recurrence. It is an acknowledged fact that an attack of erysipelas predisposes to a second, and a patient who has once been attacked by this disease is more prone to have it again than one who has never suffered—a marked contrast to the comparative immunity which an attack of smallpox, scarlet fever, or measles undoubtedly confers on the individual. Other minor points in which it differs from these fevers may be also noted: thus the incubation is sometimes short or even altogether absent; occasionally there is no premonitory fever; the stages are by no means uniform, and the local affection is limited to portions of the skin.

Again, others have regarded erysipelas as a purely local disease, and have based their opinion on the assumption that, if it can be shown not to be a specific disease, therefore it must be a local one. But this is not borne out by facts, for though the inflammation usually starts from a local injury or wound, it may, and sometimes does, start from quite a different part of the body from that where the injury is situated. For instance, an amputation of the foot has been followed by erysipelas of the head and face, occurring a few days after the operation, and rapidly proving fatal. Or, indeed, the erysipelas may commence without the slightest wound or abrasion anywhere, though this is by no means common. Or, again, it may attack internal parts or organs. Furthermore, it is, undoubtedly, contagious. It is usually preceded by obvious constitutional disturbance and accompanied by well-marked fever. All these arguments are strongly against the theory of the local nature of erysipelas.

Of late years the belief has been frequently expressed, and has certainly been gaining ground, that erysipelas is due to the presence of bacteria in the system—the term 'bacteria' being here used in its widest sense, as signifying micro-organisms.

Nepveu, as long ago as 1872, found them in the blood of four patients suffering from erysipelas. Orth has found them in the bullæ of erysipelas. Lukomsky has found them in the lymphatic vessels of the skin affected with the same disease. Billroth and Ehrlich have found them, not only in the lymphatics, but also in the blood-vessels. More important, however, are the observations of Von Recklinghausen, who states that, in spreading erysipelas, micrococci were found in the lymphatic spaces and lymphatics belonging to them, where the process was recent and in progress; but that where the erysipelatous inflammation was in the retrogressive stage, no micrococci were present. In other words, they were present only in what may be termed the progressive zone, at the edge of the extending inflammation, and *not* in the tissues at a distance from the margin of extension. The discovery of bacteria in the tissues affected with erysipelas does not, however, substantiate the germ theory; something further than this is necessary. It must be proved that these organisms, which have been seen to exist in the tissues affected with erysipelas, are the true causal agents of the disease. This has been done by a series of conclusive experiments conducted by continental observers. Orth injected under the skin of a rabbit the contents of an erysipelatous bulla, in which he had satisfied himself, by microscopic examination, that there were numerous micrococci. This produced an inflammation entirely analogous to erysipelas in man. The œdematous fluid from the erysipelatous tissues of this rabbit was injected into a second, with the effect of producing a similar characteristic inflammation. In the affected parts of the skin of the second rabbit large quantities of micrococci were found.

Lukomsky has also found that an affection exactly similar to, if not identical with, cutaneous erysipelas, can be induced by the subcutaneous injection of fluids containing bacteria, or by the application of similar fluids to any raw surface; and, furthermore, that the contents of erysipelatous vesicles, *free from bacteria*, do not usually produce any morbid phenomena.

At the International Medical Congress in London, Dr. Koch showed photographs of micro-organisms which he had found at the periphery of erysipelatous tissue, and which he believed to be pathogenetic of erysipelas. These have since been proved, by a conclusive series of researches by Fehleisen, to be present in every case of erysipelas which he examined, to be capable of cultivation, and also of successful inoculation both in man and the lower animals. In every one of thirteen cases examined micrococci were found, which were identical with those figured by Koch in his photographs. Fehleisen succeeded in breeding the micrococcus to the fourteenth generation by cultivation of some small portions of skin in Koch's 'flesh-infusion peptongelatine,' and he states that, though he found organisms in connection with other pathological processes, they never behaved in the same manner as regards their cultivation. He next proceeded to a series of experiments on rabbits. In every instance, except one (where there was only a slight rise of temperature), the characteristic erysipelatous rash appeared at the end of about thirty-six to forty-eight hours, being preceded by a rise in temperature. The disease ran a definite course of about six to eight days, the redness spreading to the root of the ear and thence to the head and neck, unaccompanied by suppuration, and terminated in recovery. In every case micrococci were found in the lymphatics of the affected part.

In addition to the experiments on the lower animals, Fehleisen tested the virulence of these organisms by inoculations in the human subject, on the principle that an attack of erysipelas has often a beneficial effect in such diseases as cutaneous tumours, lupus, and even malignant growths. In the first case he inoculated the gluteal region of a woman suffering from multiple fibrosarcomatous tumours. On the evening of the same day there was a slight rise of temperature, and the following morning a rigor. On the morning of the fourth day there was a second rigor, and on the left buttock was found a sharply defined, slightly raised, reddened surface, having all the characteristics of erysipelas. The temperature was 105° F. The redness spread considerably during the day, and continued doing so until the seventh day, when the erysipelas occupied an area of a square foot. It then remained stationary for three days, and began to diminish in intensity. On the fifteenth day the temperature was normal. In six other cases Fehleisen inoculated the pure or cultivated micrococci, and erysipelas was induced in five of them, and ran a typical course to a favourable termination. As regards the therapeutic effects, in two cases only does any permanent benefit appear to have been derived. One, a case of lupus, was reported to have been almost entirely cured, and in another, an instance of cancer of the breast, which had already been operated on three times and presented several large tumours adherent to the skin, the erysipelas was followed by an entire disappearance of the cancerous growths which, up to the time of the report, had not reappeared.

Fehleisen also made some experiments on disinfection. He found that a three per cent. solution of carbolic acid, in forty-five seconds, rendered the organisms incapable of further cultivation, and the same effect was produced by a solution of corrosive sublimate in fifteen seconds. These researches appear to be quite conclusive, and should they be confirmed by other observers, the etiology of erysipelas may be considered to be fairly established, and the list of diseases due to a specific micro-organism is thus enriched by one.

B. *Exciting Causes.*—The poison of erysipelas being thus due to a materies morbi introduced from without, either through the atmosphere or by actual contagion, it is palpable that a wound must be a common *exciting* cause. Other exciting causes have been alleged to produce erysipelas, such as exposure to severe draught, a sudden chill, application of cold to the loins, and even fright. But these causes, even if they really exist, are by no means so potent as the presence of a wound. Some pathologists have believed that they have no existence. Billroth says: 'I am very doubtful whether erysipelas ever develops except from a wound, or from some pre-existing cause of inflammation.' Trousseau says: 'Observe with attention that the erysipelas described under the names of medical and non-traumatic has almost always a starting-point, which though it cannot, strictly speaking, be called a wound, is at least a lesion—a very slight lesion it may be in some cases.' Any wound of any size, in any stage of its progress, may be the exciting cause and the starting-point of erysipelas. Thus, a leech-bite, the sting of an insect, scarification of parts affected with œdema, the wound made in venesection, are all known as exciting causes of the disease. So, again, a perfectly recent incised wound, as in the removal of a sebaceous tumour of the scalp; or a contused and lacerated wound, as in a compound fracture of the leg; a healthy granulating sore, or an old sinus, may all be the starting-point of the disease. There seems, however, to be no doubt that erysipelas is more prone to attack a wound, when its secretions are retained and have become decomposed in the tissues.

C. *Predisposing Causes.*—These must be considered under two heads, either as affecting (1) the patient, or (2) his surroundings.

1. *In the patient himself.*—Believing that the efficient cause of erysipelas is due to micro-organisms, we know that the healthy blood is not favourable to their growth, and that the healthy body appears to be the most unfavourable habitation for them. Mr. Watson Cheyne and other observers have indeed asserted that in the

healthy state of the animal body there are no micro-organisms present among the tissues. Other pathologists again, though they consider it an accepted fact that these organisms may be present in the blood and tissues of healthy living animals, nevertheless assert that they are only to be found in very small numbers, and often only after the most elaborate preparation and careful examination. All, however, are agreed that the healthy living body is able to fence itself against the permeation of the blood and tissues by these organisms, unless, indeed, they be introduced in very large quantities. The investigations of Mr. Cheyne have an important bearing on this subject. He found that by lowering the system of an animal by the administration of phosphorus, he brought about a condition of system which permitted the introduction of micrococci in enormous quantities. The experiments of Professor Roshbach are also of importance in connection with this point. He found that by the injection into the blood of a chemical ferment, itself perfectly free from any organism, he produced such a change in the properties of the fluids of the body that bacteria were developed in immense numbers in the course of a very short time. The vegetable ferment used was papayotin, and having previously examined the blood of several rabbits to establish the absence of bacteria, he injected small quantities of a freshly-prepared solution of papayotin into a vein. Death of the animal took place in an hour or two, and the blood examined immediately after death exhibited, without exception, countless numbers of round and oval bacteria. In considering, therefore, the predisposing causes of erysipelas as regards the individual, we must believe that there are certain conditions of the blood in which bacteria become endowed with vitality and with reproductive powers.

The experiments of Mr. Cheyne, above alluded to, show that lowering the system will produce this result, and thus we find that a vitiated condition of the blood induced by habitual intemperance, or want of proper food, or by disease of the eliminatory organs, especially Bright's disease, or diabetes, or disease of the liver, are amongst the foremost predisposing causes of erysipelas, producing a condition of the system in which the poison appears to find a soil peculiarly favourable to its growth. A similar vitiated condition of the blood, rendering the patient prone to erysipelas, may be induced by over-exertion or long exposure to wet or cold, and in women by amenorrhœa. Mental emotions, and especially prolonged anxiety, no doubt through their general effect upon the system, may also be classed in the same group of predisposing causes. There are other causes, in which it becomes a question whether there is a special pathological condition of the blood, which renders it favourable to the introduction of bacteria. So great is the constitutional predisposition to erysipelas which some persons appear to possess, that the slightest cause produces an attack. And, again, there is the occurrence of a previous attack, which predisposes to a second. M. Verneuil records the case of a woman who had had seventy-nine attacks of erysipelas of the face; and some years ago a nurse in St. George's Hospital, who suffered from chronic eczema of the face, had an attack every spring and autumn. Again, the disease is said to be hereditary in some instances. Finally, erysipelas sometimes occurs in women at the menstrual period, and is stated to be more common in the female than the male. Age and occupation do not appear to have any influence on the disease.

2. *In the patient's surroundings.*—It is an incontestable fact that, under certain conditions, erysipelas is much more common and prone to attack wounds than under ordinary circumstances. Whether these conditions are atmospheric or not, with our present state of knowledge we are unable to say, though it has been asserted, but without any really reliable evidence, that the spring and autumn, east winds, a very moist atmosphere, and a low temperature, are conditions under which erysipelas is apt to occur as an epidemic. All that we can say at present is that the poison propagates and develops with greater vigour and energy under certain conditions or seasons than at others. More potent causes are bad ventilation and generally faulty hygienic conditions, and especially a vitiated atmosphere from the presence of decomposing vegetable and animal matters. It is well known that micro-organisms swarm in all putrefying solutions and mixtures of organic matter; the presence, therefore, of decomposing organic matter forms a hotbed for the production and growth of the special infective organisms of erysipelas, which become developed in such countless numbers as to overcome the resistance which the healthy living body appears to have to their reception, and they are admitted into the system either through an open wound, or by the respiratory passages or alimentary canal, or through the openings of the count-

less ducts, either cutaneous or mucous, and thus an attack of erysipelas is the result.

Pathology.—By an examination of the inflamed part, dilatation of the vessels of the cutis, with serous exudation into the surrounding tissues, can be anatomically demonstrated. Volkmann and others have shown that many white corpuscles are found collected around the vessels; and Hillier states that microscopic examination of the blood before death proves that many of the white corpuscles have undergone a process of degeneration, and become converted into highly refracting bodies. This change probably is only to be observed in the later period of the disease. It seems probable, from the manner in which the redness spreads in circumscribed patches, which are well defined, that the specific poison (micrococci) is introduced into the system by the lymphatic vessels; that it spreads along the superficial lymph-vessels of the skin, and more deeply through the subcutaneous vessels, giving rise to streaky redness and enlargement of the corresponding lymph-glands. This coincides with what has actually been demonstrated in numerous experiments. Lukomsky, for instance, found that when fluid, holding spores of fungi in suspension, was subcutaneously injected, it became widely distributed through the lymph canalicular system and lymphatics. Fehleisen, in the examination which he made of thirteen cases of erysipelas, found the micrococci in the superficial layer of the corium and subcutaneous tissue filling the lymphatics and lymph spaces, while the rest of the tissue showed cell-infiltration. He found no organisms in the blood-vessels, though other observers have stated that they have done so. When the subcutaneous tissue is involved in the disease (phlegmonous erysipelas) it is found, in the early stage, to be distended with serum, which soon becomes turbid, and, later on, is converted into shreddy sloughs, infiltrated with a puriform fluid. The postmortem examination of cases of erysipelas presents nothing characteristic — merely those pathological changes which we are accustomed to associate with some altered condition of the blood, due to the absorption into it of some septic influence. Thus, the blood is fluid, thin, and uncoagulated, often black and pitchy, staining the lining membrane of the heart and its valves, and the large blood-vessels. The spleen is soft and diffluent, and the kidneys often congested. The lungs are also often highly congested; and, according to Busk, the smaller pulmonary vessels contain blocks of altered white corpuscles; and Bastian has described a similar condition in the vessels of the brain.

Symptoms and Diagnosis.—As a rule, erysipelas is preceded by considerable constitutional disturbance, sometimes of a very severe character, which ushers in the attack. At other times the amount of constitutional disturbance is very slight, so that it escapes the patient's notice, and thus the appearance of the local mischief is the first thing which attracts attention, and therefore it has been supposed that the disease may occur without any general symptoms. The severity of the premonitory fever is no indication, however, of the amount of local inflammation which is to follow. In some cases, where the early constitutional disturbance has been so slight as almost to pass unnoticed, the subsequent disease has proved to be of the most severe nature, and to be accompanied by a fever of the most marked and asthenic type; and in other cases where the premonitory fever has been severe, the following inflammation has been slight, and has terminated in resolution in the course of a few days. The disease is ushered in with a feeling of malaise, and general disinclination on the part of the patient to go about his ordinary occupations. There is a general chilliness, sometimes, though seldom, amounting to a distinct rigor, with headache and nausea, occasional vomiting and sense of oppression, and even pain in the precordial region.

The advent of these symptoms is generally sudden, and is marked by a rapid rise in the temperature, so that the chart will exhibit an increase of 4° or 5° between the morning and evening registrations. The skin is hot and dry, and the tongue coated with a creamy fur. In addition to these symptoms, occasionally a severe attack of epistaxis or, in children, convulsions, will usher in the disease. These general symptoms are followed usually, on the second or third day, by the appearance of the local inflammation; there does not appear to be any definite time for the characteristic redness to show itself; it may be within twenty-four hours of the first rise of temperature, or it may be delayed till the fifth or sixth day. Sometimes swelling and tenderness of the lymphatic glands in the neighbourhood of the wound, if there be one, precedes the appearance of any redness of the skin, and this becomes an important indication of the advent of an attack of erysipelas. That is to say, as has been pointed out by Frank, Busk, and others, a sudden rise in temperature and general febrile disturbance, attended by pain and swelling of the lymphatic glands in any region of the body, are very often indicative of an attack of erysipelas.

After the appearance of the local symptoms the fever rapidly assumes a marked asthenic type. The pulse is quick and weak, becoming weaker as the disease progresses, though its frequency is maintained. By Nunneley, Hinckes-Bird, and Campbell de Morgan it has been asserted that if the pulse rises in frequency after the sixth or seventh day it is a bad sign, betokening a fatal termination. The statement, however, appears to require further corroboration, and certainly must not be looked upon as universally true. The temperature remains high during the whole of the time the local inflammation is extending, ranging between 102° and 105° F., or even slightly higher, every fresh access of inflammation being marked by a rise in the temperature. As soon as the redness ceases to extend the temperature falls, oftentimes very rapidly, so that it frequently becomes normal, or almost normal, some time before the tongue has cleaned and the pulse dropped to its ordinary standard. The tongue, which during the premonitory fever is generally coated with a creamy fur, speedily becomes brown and dry. The bowels are generally constipated, and the motions dark and offensive. Towards the termination of the case, when the disease is subsiding, an attack of diarrhœa not infrequently sets in. This, however, may be present from the first, and is sometimes attended by a yellowish or jaundiced tingeing of the skin—a variety of the disease to which the older writers were wont to apply the term of 'bilious erysipelas.' The urine is generally scanty, loaded with lithates, and very constantly contains a trace of albumen. When the disease is subsiding it may contain a large quantity of albumen, with epithelium from the renal tubules, due to a temporary congestion of the kidneys. In severe cases of the disease, especially where it attacks the head, the patient may suffer from delirium of a low, muttering type. This is due to the condition of the blood, not to any extension of the inflammation to the membranes of the brain. Dr. Bastian suggests that the delirium may depend upon the plugging of the small arteries and capillaries of the brain with embolic masses of white blood-corpuscles—conditions which he found to exist in the case of a man who died from erysipelas with delirium and stupor.

Erysipelas has been defined as a spreading inflammation of the skin, or of the cellular tissue beneath it. It is therefore convenient to divide it for the purposes of description into (1) simple cutaneous erysipelas, affecting only the skin, the subcutaneous tissue being only very slightly, or not at all, affected; and (2) phlegmonous or cellulo-cutaneous erysipelas, in which the inflammation affects, not only the skin, but the cellular and adipose tissues beneath, and often runs on to suppuration. A third variety is sometimes added to these—the cellular erysipelas, or diffuse cellulitis of Nunneley, where the inflammation is confined to the subcutaneous tissue, the skin remaining unaffected, or where the inflammation attacks cellular tissue in places where there is no skin, as in the pelvic cellular tissue, or the areolar tissue between muscles or beneath fascia. The name is often confounded with phlegmonous erysipelas, which should be avoided, as leading to confusion. It is considered under CELLULITIS.

I. *Simple Cutaneous Erysipelas.*—The local inflammation usually starts from a wound or abrasion. It may, however, commence at the point of junction of the mucocutaneous surfaces, a not unusual situation being the inner canthus of the eyelid, whence it spreads over the bridge of the nose. The angle of the mouth, the external auditory meatus, and the margin of the anus are also situations at which the disease occasionally commences. Lastly, it may commence on the mucous surfaces, notably those of the pharynx and nasal fossæ, and spread outwards to the skin. This is not a form of metastasis, as was formerly supposed, but a true spreading of the disease from the one surface to the other, the inflammatory redness, when the pharynx is the part first affected, spreading to the nasal mucous membrane and first appearing on the cutaneous surface at the orifices of the nostrils, and thence spreading to the nose, cheeks, eyelids, and other parts of the face.

At the outset the skin, as a rule, becomes of a bright red or rose-tint. The colour, however, may vary: sometimes there is a decided yellowish tinge, sometimes it is a deep livid red. The redness disappears on pressure, but immediately returns upon the pressure being removed. The affected part is also swollen and slightly œdematous, pitting on pressure. The limits of the inflammation are sharply defined, the redness not gradually fading away into the natural colour of the skin, but presenting an abrupt, though irregular, outline. On passing the finger lightly over from the margin of the inflamed tissue to the normal skin, the swollen condition of the former will be plainly noticed by the marked elevation which will be felt at the line of junction. In the simple cutaneous erysipelas the œdema, as a rule, is not great, unless in situations where the cellular tissue is very loose and lax, as in the eyelids and scrotum; here there is generally very considerable œdema, which often runs on to suppuration; otherwise the formation of pus does not usually result from this form of erysipelas. In many cases the inflamed part is covered over with vesicles or even blebs. These at first contain clear serum, which in the progress of the disease becomes semipurulent. They burst, and, drying, form scabs on the surface, which, however, separate without ulceration. Occasionally these bullæ will be found to contain reddish or purplish contents, from infiltration with blood-pigments. This is always an unfavourable sign, as indicating a weakened condition of the system.

At first there is stiffness complained of in the part, accompanied by tingling and itching; this is succeeded by a burning sensation and a feeling of tension. Occasionally we find that there is an entire absence of pain, but there is always more or less tenderness on pressure; sometimes there is a very exalted sensibility of the nerves, so that the application of even a piece of lint is distressing to the patient, and the slightest touch elicits an expression of pain. The redness spreads widely—in fact, it may spread all over the body, but always maintains the same defined margin; usually it spreads more in one direction than another, and especially along the course of the lymphatic vessels. The manner in which it spreads is worthy of observation. On carefully examining the margin of a spreading cutaneous erysipelas, there will often be noted to be circumscribed, reddened, and somewhat rounded patches, which spread until they become merged into the already diseased parts. This confirms the opinion that the poison travels principally by the lymphatic system, and that these isolated patches are certain lymph-vascular districts which become primarily affected, and thence merge into the general disease.

The characteristic tint will usually be found to be most marked at the borders of the spreading inflammation, the redness having a tendency to fade in the centre as it spreads at the circumference. The inflammation, though principally affecting the skin, is not confined to it, but the subcutaneous tissue is more or less involved; and where this is loose or lax, as in the face, very considerable swelling takes place, obliterating the features and giving to the countenance a bloated and hideous expression.

The duration of erysipelas is very uncertain. It usually lasts from two to ten days, but may be prolonged to the end of the third week, or even, in some rare cases, for a longer period, and nevertheless terminate in recovery. Coincidently with a sudden fall of temperature the redness begins to disappear and desquamation takes place, the epidermis peeling off, partly as a branny powder and partly in scales. With the disappearance of the redness the swelling usually subsides; should it persist, suppuration may be expected. When the disease attacks the scalp the whole of the hair may fall off, but speedily grows again. Even after a mild attack the patient's strength is much reduced, and relapses are by no means uncommon.

Although œdema is almost always more or less present in erysipelas, so as to produce a certain amount of pitting, yet in some states of the system the inflamed tissues become loaded with serum, causing them to be excessively œdematous, and giving rise to a condition which has by some been regarded as a distinct variety, and to which has been given the name of 'œdematous erysipelas.' This condition occurs in those who are debilitated by previous illness or whose constitutions have been broken down by visceral disease. The inflamed parts are much swollen, the redness, instead of being bright and rose-coloured, is of a dusky hue, and there is a greater tendency to run into gangrene. The condition is a serious one, not so much on account of the local mischief as on account of the constitutional state which has given rise to it.

Erysipelas has a tendency occasionally to assume an erratic form—that is to say, it will subside in one part of the body and break out in another. Closely allied to this is the 'metastatic' erysipelas of some authors, where the inflammation suddenly disappears from the surface of the body and simultaneously attacks some internal organ. This condition, however, is extremely rare.

Simple cutaneous erysipelas is not often fatal unless complicated with some visceral mischief, or when it attacks the head and neck. Instances of the former—where, for instance, a patient suffering from granular degeneration of the kidney is attacked by erysipelas—are not uncommonly fatal; and, when the disease attacks the head and neck, fatal results may ensue either from congestion of the brain from the mechanical impediment to the return of the venous blood, or from the disease extending to the pharynx and air-passages and producing œdema glottidis, or from the spread of the disease to the interior of the chest.

After the eruption of erysipelas has become fully developed it is scarcely possible to mistake the disease. Prior to this, when in the progress of a case, either with or without any apparent change in the wound, there is a sudden rise of temperature with other febrile symptoms, attended with pain and swelling of the lymphatic glands in the neighbourhood, the advent of an attack of erysipelas may be suspected but cannot perhaps be confidently predicted. The appearance of the rosy-red sharply-defined blush establishes at once the diagnosis. We may hesitate for a moment as to whether it is a simple inflammation of the subcutaneous tissue or a lymphangitis; but the absence of the sharply-defined border in the one case and the course of the disease in the other will speedily determine the point.

II. *Phlegmonous Erysipelas.*—This form of erysipelas usually occurs in patients of broken-down constitutions, either the result of habitual intemperance or from some disease of the liver or kidney. It differs from the preceding variety in the degree of inflammation, in the depth to which the tissues are involved, and principally in the fact that it almost always runs on into suppuration and sloughing. For, whereas in the cutaneous form of erysipelas it has been shown that suppuration, except in places where the subcutaneous tissue is very loose and lax, rarely or never takes place, and, when it does, is not accompanied by sloughing; in the phlegmonous variety the involved cellular tissue for the most part falls into a condition of extensive suppuration and gangrene. The constitutional symptoms which usher in and accompany the inflammation are more severe. The invasion is marked by more pronounced general disturbance, a rigor being a frequent precursor of the local inflammation; and the accompanying fever, at first, of an active inflammatory character, often suddenly becomes asthenic. The temperature is high from the first, the thermometer often registering 103° to 106° F. The pulse, full and bounding at the commencement, soon loses power, becomes weak and quick, and, especially in fatal cases, irregular and intermittent. The tongue is dry and brown, and the teeth become covered with sordes. Diarrhœa often sets in from the first and the motions are offensive. In the latter stages delirium, of a low, muttering character, and subsultus are present, the patient often lying in a semi-unconscious, wandering condition, from which he can be temporarily aroused, but into which he again speedily relapses.

The constitution often gradually gives way from the exhausting influences of the disease, and death supervenes; or a fatal issue may occur from some complication, as pneumonia or pleurisy. Should the patient survive the stage of sloughing, pyæmia or septicæmia not uncommonly supervenes; or hectic, with diarrhœa, may carry him off.

Phlegmonous erysipelas is generally the result of wounds penetrating the subcutaneous tissue. It is therefore not uncommon after scalp wounds involving the aponeurosis of the occipito-frontalis muscle, or in compound fractures of the extremities. It may, however, occur without any wound or abrasion. From the commencement there is marked œdema, so that the swelling is great and pits on pressure. The part is red, but the redness is of a more dusky hue than in the cutaneous form, and does not present the same well-defined abrupt margin. It is often covered with large vesicles or blebs containing sero-purulent fluid, sometimes with a sanious tinge. After a time the tissues become hard and brawny, and no longer pit on pressure; the redness becomes deeper. Pain of a severe burning and tensive character is complained of. The inflammation spreads, so that in a day or two the greater part of a limb may be involved. The redness becomes deeper and deeper, and purple patches appear. About the fifth or sixth day from the commencement of the inflammation an arrest of the symptoms appears to take place; the inflamed parts become soft and boggy, and pitting again takes place on pressure. If an incision be now made into the affected part the areolar tissue will be found to be loaded with an opaque fluid, giving a gelatinous appearance to the sides of the incision. This fluid speedily breaks down and becomes puriform, and the cellular tissue becomes the seat of suppuration and death. The purple patches on the surface become livid and break down. The pus which escapes is fetid. From time to time large masses of gangrenous tissue protrude from the openings and are discharged, or can be drawn out by the surgeon. The skin around, being deprived of its proper blood-supply, perishes and gradually sloughs away. And thus, in extreme cases, a whole limb may be denuded, fasciæ and muscles exposed, joints opened and destroyed, and bones deprived of their periosteum and thrown into a condition of necrosis. If the patient survive, there will be tedious cicatrization of the deep cavities which have been left, often leading to such contraction and deformity as to render the limb permanently disabled.

As a rule there is no difficulty in distinguishing the phlegmonous from the cutaneous form of erysipelas, when the disease is fairly established. It must be noted, however, that the severer form of the disease occasionally presents at first the same appearances as the simpler form, and it is not until the greater swelling, with the brawny hardness, has appeared, that a definite diagnosis can be arrived at. These signs, with the absence of the well-defined margin to the redness, at once establish the formidable nature of the disease. Phlegmonous erysipelas may be mistaken for diseases with which it is frequently associated, as phlebitis and inflamed absorbents. In the former, however, as a rule, the swelling is confined to the course of the vessel, and the hardened vein can be traced; and even if this is not so, and the swelling is more diffused, still the amount of redness, which is much less in phlebitis than in phlegmonous erysipelas, is indicative of the nature of the disease. From inflamed absorbents, the condition of the glands, exquisitely tender and speedily running into suppuration, and the streaky character of the redness are the principal points which must be relied upon in coming to a correct diagnosis.

Erysipelas occasionally attacks the mucous membrane of the pharynx. It may occur here either by spreading from the face, or it may commence as a primary affection in this part, and extend outwards through the nasal fossæ, and appear on the face at the orifices of the nostrils. When it begins as a primary affection in the pharynx, there is much pain in the throat, a sudden rise of temperature, and considerable pyrexia, with enlarged glands about the angle of the jaw. There is vivid redness of the soft palate, fauces, and back of the pharynx, with considerable swelling. There is often huskiness or complete loss of voice. It may be mistaken for ordinary catarrhal sore-throat, but in these cases the symptoms are not usually so severe, the pain is less, the redness not so vivid, and the swelling not so great. The appearance of the characteristic redness at the orifice of the nostrils establishes the diagnosis. The danger of this affection arises from its tendency to spread downwards to the mucous and submucous tissues of the larynx, constituting *œdema laryngis*, and speedily threatening life from suffocation.

Erysipelas also sometimes attacks newborn infants (*Erysipelas neonatorum*). When it occurs during the first fifteen or twenty days of life, it is almost inevitably fatal. It generally begins to show itself about the pubes or umbilicus and rapidly spreads, accompanied by extreme prostration, terminating the life of the child in from five to seven days. Trousseau regards it as a *puerperal* erysipelas, and considers that the same epidemic influence affects mothers and their offspring. He says it seldom occurs except during epidemics of puerperal fever. There can be little doubt that puerperal fever is but an internal manifestation of erysipelas. The instances which have been recorded of the one disease exciting the other are too numerous to permit of any doubt of the intimate connection between the two.

Erysipelatous inflammation of serous membranes, especially of the peritoneum after operations for hernia and other wounds, is not infrequently met with. In these cases, after death the peritoneum is found to be injected, opaque, and covered with patches of greyish lymph, and the cavity contains a quantity of fluid mixed with shreds of lymph. This fluid is of an exceedingly virulent nature, inoculation of it producing the most serious and even fatal consequences.

Treatment.—The treatment of erysipelas naturally resolves itself into *general* and *local*. With regard to the former there can be no doubt that fresh air is essential, and that the first and strictest attention should be paid to the ventilation; at the same time, especially if the head and face be the part attacked, care must be taken that the patient be not exposed to any draught. All curtains and hangings about the bed should be removed, and every means taken to prevent stagnation of air around the patient.

It is essential, in all cases of erysipelas, that the bowels should first of all be cleared out by a brisk mercurial purge. Even though diarrhœa be present from the commencement, it is wiser not to omit this precaution. The diarrhœa may, and often does, arise from a loaded state of the bowels, the motions being dark and offensive, and a free purgation will not only materially improve the patient's condition, but will also often prove the best means of checking the diarrhœa, and will enable the patient to take the necessary food and stimulants with greater advantage. It must be borne in mind that erysipelas is a disease accompanied by fever; this fever having a tendency either from the first to assume an asthenic type, or, at all events, speedily to fall into this condition. The medicinal treatment should, therefore, consist in the exhibition of salines and tonics. If there be much thirst and dryness of the tongue, the salines may be given in an effervescing form; and of all tonics the one which, in the writer's experience, appears to be the most beneficial is bark, which may be combined with the salines in the form of the compound tincture. The addition of ammonia, as a diffusible stimulant, appears also to produce a good result. The medicine should be administered in frequent doses, and if there is any tendency to constipation, this condition must be corrected by an occasional purgative. If, on the other hand, diarrhœa is present, small doses of grey powder and carbonate of soda, once or twice a day, will generally be found to correct it.

The diet must be entirely fluid, consisting of beef-tea or mutton-broth and milk, and must be given in such quantities as the patient can digest. Care must be taken not to overload the stomach. In erysipelas there is always more or less derangement of the digestive organs; the stomach often rejects large quantities of food. The sensations of the patient must be our guide in this matter; if there is a loathing for food and a tendency to sickness, it must be withheld or only given in very small quantities. Stimulants are almost always required in erysipelas, sometimes even from the commencement, and occasionally in large quantities. The amount must be regulated by the pulse. If there be any tendency to flagging, and especially if it rises in frequency after the sixth or seventh day, they must be given with an unsparing hand. If, on the contrary, they produce dryness of the skin, flushing of the face, and restlessness, they have been given in too large quantities, and their amount must be reduced. The amount required will no doubt be influenced by the previous habits of the patient.

Only two drugs have any especial reputation in the treatment of erysipelas. Perchloride of iron was first recommended, in 1851, by Dr. Hamilton Bell, as a specific in erysipelas if given in large and repeated doses. He states that in it 'we possess a certain and unfailing remedy.' The experience of surgeons on this point certainly differs; for while some have found the greatest benefit from its administration, believing that it cuts short the disease, others have found it to be altogether inert, or at all events apparently producing no effect on the ordinary course of the erysipelas. In the hands of the writer it has certainly failed, though he has given it in drachm doses every two hours. The only cases in which it has appeared to have any beneficial influence have been slight cases, where there has been no derangement of the digestive system, and a clean, or comparatively clean, tongue. The other remedy is aconite, which is stated by Dr. Ringer to cut short the attack if given directly the temperature begins to rise. He recommends that it should be given in minim or half-minim doses every quarter of an hour for one or two hours, and then hourly until the temperature falls and the skin becomes moist. Its administration must be carefully watched. Salicylic acid and its compounds have been employed of late years in the treatment of erysipelas, and appear to have been useful in reducing the temperature, but do not seem to exert any specific influence on the disease.

Local Treatment.—The number of local applications which have been recommended in the treatment of erysipelas is very large, many being employed in the belief that anything which would check the local action would have a tendency to remove the general disease. Thus Neudörfer recommends the injection of a two per cent. solution of carbolic acid into the neighbourhood of the inflamed part. Professor Petersen, of Kiel, states that he has thrice arrested the progress of erysipelas by injecting a concentrated solution of salicylic acid around the diseased part. Wilde recommends the injection of a solution of sulpho-carbolate of soda (one part in twelve). He states that, in five cases, on the evening of the first day the temperature did not rise. On the second day there was a fall and the redness had begun to disappear, and on the third day œdema alone remained. With a similar object of removing the general disease by checking the local action, astringent applications have been frequently recommended. The sulphate of iron, in the form of a lotion consisting of a drachm to a pint of water, or of an ointment, half a drachm to an ounce of lard; a 30 per cent. mixture of nitrate of silver and perchloride of iron (gr. xx. ad ℥j.) in solution, have all been said to tend to shorten the disease. Collodion painted over the surface has also been recommended, and is stated to act as an astringent, diminishing and unloading the vessels. Broca recommended painting collodion around the margin of the inflamed tissue and over a space of at least six to eight centimetres in breath beyond it, and believed that in this way the disease might be arrested. Another favourite plan, which was highly recommended some years ago, but appears to be for the most part useless, is to apply a ring of lunar caustic to the healthy tissue some few lines from the inflamed part. This is said to arrest the progress of the disease when it reaches the ring. The American surgeons recommend very strongly the local application of the compound solution of bromine to an erysipelatous part. The solution is applied on lint and covered with oiled silk, and they state that, in from twelve to twenty-four hours after the commencement of the treatment, the erysipelas begins to subside. Other remedies, such as tincture of iodine, sulphurous acid in glycerine, boracic acid and glycerine, and creosote, have also been employed with the same object.

Various applications, whose aim it is to exclude air, have also had their advocates. Barwell recommends covering the surface of the inflamed part with a coating of ordinary white-lead paint, and states that the advantages derived from this plan of treatment are due to the exclusion of air. The dusting of starch and flour over the surface in a thick layer is a popular and favourite remedy, but is objectionable because it soon dries and cakes and acts as an irritant. Plain olive oil, or carbolic oil, are also remedies which have been frequently advocated. Sedative applications have also been recommended and are occasionally useful, especially when much pain is complained of. Of these, belladonna and poppy fomentations are the ones most frequently used. The belladonna may be employed either in the form of an ointment or of a paint consisting of equal parts of the extract and glycerine.

Whatever the application to the inflamed part, there are certain indications which should not be neglected. Cold must be carefully avoided; the part should be kept warm, and, as far as possible, of an equable temperature. Perhaps there is no better plan than the application of a thick layer of cotton wool, over which has been spread an ointment consisting of half a drachm of sulphate of iron to an ounce of lard or vaseline; or an ointment formed of equal parts of Ung. plumbi and Ung. calaminæ. Poultices should be avoided, and, as a rule, dry warmth will be found preferable to moist applications. Finally, strict attention should be paid to position, the inflamed part being elevated in order to relieve congestion, and this alone will often afford marked relief to the symptoms.

The local and general treatment of phlegmonous erysipelas is, in the main, the same as that of the cutaneous form of the disease as regards the earlier stages, except that support and stimulants require to be more freely given, and warm moist applications appear to be more suited to this class of cases. Later on, incisions will probably be necessary. As soon as there are signs of tension and the skin becomes brawny, they should at once be made. They should be each two or three inches in length, and carried down into the infiltrated tissues, and should embrace the whole extent of the tense parts. In the slighter forms of phlegmonous erysipelas the disease may terminate in resolution, under proper treatment, without incisions; it is not necessary therefore always to resort to them in the first instance, and if, under the influence of elevation of the part, warm fomentation, and a free purge, the skin begins to recover a paler hue, and presents a somewhat wrinkled appearance, they may be dispensed with altogether. T. Pickering Pick.

ERYTHEMA is the term used to express the clinical aspect of congestion of the skin, and may be defined as 'redness of the skin which disappears for a moment upon pressure.' Much confusion has arisen from its being employed indiscriminately for the symptom of redness, irrespective of the cause, and also for two groups of diseases —one the result of hyperæmia only, of which erythema simplex is the type, the other due to actual inflammation, represented by erythema exudativum. At the same time it must always be borne in mind that the line between hyperæmia and inflammation is a narrow one, and many of the affections which are here classed under hyperæmia are only entitled to be so in the majority of cases, while in others the process goes on to exudation. The distinction, therefore, is often one of clinical convenience rather than of pathological accuracy.

Group I.: Erythema Hyperæmicum.—In this class swelling is absent or insignificant in the congested areas, and the tint of redness varies from the brightest red to a rosy or purple hue, according to the predominance of arterial or venous hyperæmia. There are two groups—I. Those of local distribution, due to external irritation; II. those of more or less general distribution, due to internal causes.

Sub-Group I. includes *E. Simplex, E. Pernio, E. Intertrigo, E. Læve, E. Paratrimma.*

Erythema Simplex is the congestive redness due to external irritation of moderate intensity. The size and tint of the red patches vary according to the irritant, the individual susceptibility, and the activity of the circulation in the affected area. The symptoms are generally a sense of heat, and perhaps tenderness and itching of varying intensity.

Etiology.—The causes are very numerous, and may be arranged under the heads of friction. heat, cold, and various irritants—animal, vegetable, and chemical.

Erythema Pernio (*Syn.*: Pernio, Chilblains) is the well-known congestive redness, the consequence of cold, which attacks the extremities, especially the heel and borders of the feet, in young persons and those with feeble circulation. It is accompanied by extreme itching whenever the limb becomes warm, and is often very tender. If neglected or exposed to friction, the congestive stage is soon passed, and vesication, superficial ulceration, and even a small slough, may be produced. The treatment consists in adopting every measure to keep up an active circulation in the limb; warm socks, stout lace-boots, and active exercise are the best means both for prevention and cure, unless there is ulceration. If seen in the early stage, calamine lotion (the formula is given under E. exudativum) applied three or four times a day and allowed to dry on, or tincture of iodine, should be painted on (if for the hands, it may be decolourised by Liq. ammoniæ); and if the chilblain is broken, the Ung. calaminæ (B.P.), or boracic lint and oiled silk, may be used, and the limb should be wrapped up in cotton wool. *See* Chilblains.

Erythema Intertrigo is produced in fat persons and infants by the friction and moisture of two adjacent surfaces, and occurs chiefly in the neck, under the breasts in women, and at the groins in adults; while in infants it occurs sometimes in the neck, but more often on the buttocks, from wet napkins caused by urine or fæces, especially when diarrhœa exists. The lesion is at first merely redness of the skin, but very soon the red surface is covered with a muciform discharge, which differs from that of eczema inasmuch as while it stains it does not stiffen linen. This stage is, however, termed by some 'eczema intertrigo.'

Diagnosis.—The diagnosis from eczema is not very important practically, and consists in the circumstances and position in which the affection occurs and the difference in the quality of the discharge. In infants it is of more consequence to distinguish between intertrigo and the erythema of congenital syphilis. Intertrigo is limited to the buttocks and genital region, while the syphilide extends much further down, even to the heel, and there are very often mucous tubercles at the anus or some ulceration, and some other specific symptoms would almost surely be present. Syphilitic infants are also more liable to ordinary intertrigo. *See* Congenital Syphilis.

Treatment.—This consists in carefully cleansing the parts and applying a dusting powder, such as oxide of zinc one part and starch or kaolin three parts, and placing a piece of lint between the adjacent surfaces. In infants wet napkins should always be removed instantly, and the parts washed with Castile soap, carefully dried, and dusted over with a powder such as above indicated; or where there is diarrhœa, boracic acid, gr. xx., to vaseline alb. ℥j. is often preferable, as the grease protects the buttocks from the moisture. Diarrhœa or other defects, whether in diet or general health, should receive special attention.

Erythema Læve is the term applied to the redness which often occurs in œdematous limbs, especially in the legs.

Erythema Paratrimma is the congestive redness over a bony prominence that precedes a bed-sore. Neither this nor the preceding term are much used at the present day.

Sub-Group II. includes *E. Roseola. E. Scarlatiniforme, and E. Fugax.*

Erythema Roseola, or 'roseola' as it is often called, comprehends a certain class of erythemas which are not of so bright a hue as the others—viz., rosy red. They may be idiopathic or symptomatic.

Idiopathic Erythema Roseola occurs mainly in infants and young children, from disorders of the alimentary canal. There is often some constitutional disturbance, a transitory elevation of temperature, sometimes amounting to 2° or 3° F., and perhaps some redness, without swelling, of the palate and fauces, but no catarrhal symptoms. After a short but variable period the eruption appears; it may be general or affect only a single region; it is very variable in size and shape—in patches the size of the end of the finger, or faintly papular, in rings or gyrate figures; it may come at one place and go at another, and so last several days. Willan gave separate names to these phases of eruption, such as R. infantilis, æstivalis, autumnalis, annulata, but they are entirely superfluous and now almost obsolete. The eruption may occur in adults of both sexes, and the cause is often quite obscure.

Symptomatic Erythema Roseola is applied to those eruptions which precede or accompany the onset of the more characteristic eruption of vaccinia, variola, and syphilis, or which is sometimes seen in cholera, diphtheria, and miliaria (R. febrilis). It does not require a separate description, as it is only a part of these diseases.

Diagnosis.—This is the most important point in these affections, as the eruption may be mistaken for measles, rötheln, or scarlet fever; but the disease is not contagious, and not a part of an epidemic influence. There are none of the special prodromal symptoms of the exanthemata, such as catarrh, cynanche, &c., nor does the eruption appear at a definite time from the onset of symptoms, nor always begin in a special region; the febrile symptoms are more transitory and not in proportion to the eruption; the eruption is not concentric like measles, nor is it punctiform like scarlet fever, and it is irregular in form and arrangement. The diagnosis from rötheln is sometimes difficult, as there, too, the febrile symptoms are transitory, and there are no reliable differences in the eruption for all cases. But the contagious nature of rötheln, and the other criteria already mentioned, will assist in forming a correct conclusion; still, in a doubtful case, it is always best to act as if the disease were infectious.

Treatment.—As idiopathic roseola always gets well of itself in a few days, simple measures, such as a mild saline aperient, a bland liquid diet, protection from alternations of temperature, and the removal, if possible, of all sources of peripheral irritation, such as may arise from dentition, worms, &c., will be sufficient.

Erythema Scarlatiniforme is closely allied to E. roseola. The rash, as its name indicates, is almost exactly like the punctiform eruption of scarlatina, but is often defined at the edge with an interval of white skin between the erythematous areas. There are generally transitory febrile symptoms, such as a temperature of 101°—seldom more—and the rash subsides in from two to six days, and is often followed by copious desquamation.

Etiology.—The eruption may be of septicæmic origin. It is seen not infrequently after surgical wounds, though less often since antiseptic precautions have been generally adopted; where pus is shut up in a cavity—e.g. abscesses, tubercular peritonitis, empyema, in puerperal women; and preceding, or in the course of, enteric fever. A precisely similar rash sometimes follows the use of certain drugs, such as copaiba, quinine, belladonna, and salicylic acid. In these cases the eruption is probably due to irritation of the alimentary canal acting reflexly on the vaso-motor centre.

The rash itself requires no separate treatment.

Erythema Fugax is more closely allied to urticaria than to the other erythemata, and is characterised by transitory patchy redness upon the face and trunk, occurs chiefly in the young, and disappears after lasting a few minutes or hours. In children it is frequently due to irritating ingesta, worms, or other causes of irritation of the alimentary canal; it may also follow exposure to alternations of temperature or mental emotion, while frequently the cause cannot be traced. The treatment would be that for urticaria.

GROUP II.: ERYTHEMA EXUDATIVUM.

Definition.—Acute inflammatory diseases characterised by symmetrical, raised lesions of some deep shade of red, extremely diverse in size, shape, and degree of elevation.

This group includes E. multiforme, E. or Herpes iris, and E. nodosum.

Erythema Multiforme, as its name suggests, is very variable in its aspect, chiefly from differences in the size and shape and aggregation of the lesions, but also from the occasional formation of vesicles or bullæ upon, or the occurrence of hæmorrhage into, the primary lesion.

Etiology.—This is often obscure in the most important particulars; it may occur in both sexes and at any age, but is most common in the young. It is most frequently seen in the spring and autumn, but is not limited to those seasons, and recurrences often happen at the same time of the year in the same individual. Rheumatism appears to be a predisposing cause, and certainly previous attacks lead to others. Sudden alternations of temperature, especially when over-heated, are probably the most common agents in determining the onset, and the writer has known exposure to the sun and brine-laden winds to act as a certain excitant in individual instances. Irritation of the urethra is another cause, so that it may occur in the course of gonorrhœa. It is seen sometimes in association with endocarditis or acute rheumatism or simple synovitis, and is then probably a consequence of some toxic element in the blood. In erythema or herpes iris the same general statement may be made, except that it is not so intimately related to rheumatism, and that occasionally errors in diet or, in rare instances, a local irritant, such as mercurial inunction, has determined an outbreak. Erythema nodosum commonly occurs in children and young adults, and for the rest, what is known of its etiology corresponds with E. multiforme.

Symptoms.—The onset of the eruption is usually preceded and accompanied by constitutional symptoms, sometimes of considerable severity, such as malaise, pain in the head, back, and limbs, especially the joints, leading sometimes to the suspicion of acute rheumatism; the temperature is raised to 100° or even to 104° F., with a corresponding pulse-rate, and perhaps gastric disturbance; on the other hand, in some cases these symptoms are absent, or so slight as to be scarcely appreciable. After a varying interval of from one to four days the eruption appears, usually upon the backs of the hands and feet, and subsequently in crops upon the face, trunk, and rest of the limbs, most abundantly round the most painful joints.

The extent of distribution is very variable, sometimes being pretty general, including even the mucous membranes; at others limited to one or more regions, but it is seldom absent from the back of the hands whatever other regions may be affected. The symmetry is not absolute, the eruption being sometimes later and less developed on one side. It commences in the form of deep red papules varying in size from a pin's head to a small split pea, slightly raised and obtusely conical or convex (E. papulatum). These may coalesce into large plateaux, but when discrete speedily enlarge to the size of tubercles (E. tuberculatum or tuberosum), and continuing to develop peripherally, the centre becomes depressed, of a purplish hue, and a ring is formed (E. circinatum, or annulare); still enlarging, and meeting adjoining lesions, the ring is broken and gyrate curves are produced (E. gyratum).

Closely allied to this is E. marginatum, which, beginning as a flat disc one quarter or half an inch in diameter, rapidly enlarges at the periphery, subsiding *pari passu* at the older part, and, joining with similar lesions, the raised border rolls onwards, as it were, and traverses the circumference of a whole limb, or a large part of the trunk, leaving distinct, fawn-coloured pigmentation to mark its course. Whilst some of these changes are going on in the part first attacked, crops of papules may be coming out elsewhere and passing through the same phases as the older ones; thus it sometimes occurs that many of the variations in the appearance above described are seen simultaneously on different parts of the body.

As accidental features, vesicles or bullæ may form on the erythematous lesions (E. bullosum), or hæmorrhages may occur into them, and the affected extremities may be generally œdematous and livid. It must not, however, be supposed that the above description applies to all cases; generally the eruption stops short at one or other of the phases, and often the same kind of eruption occurs in each succeeding attack, and in these instances the separate names mentioned justify to some extent their existence. Erythema papulatum is the most, and E. marginatum the least common of these forms.

Herpes Iris.—This eruption is conveniently considered as a separate variety, because the vesicular eruption generally occurs independently of the other forms; but it is very closely allied to the annular variety of E. multiforme, which may present similar concentric rings of various colours, and is then called E. iris.

Symptoms.—The eruption is preceded by a stinging and itching sensation, usually at night, then a small, red, slightly raised, flat papule appears, and in about twelve hours is covered with a vesicle, surrounded by a narrow red line; the lesion spreads at the periphery, the centre first flattening and then becoming depressed. This is now of a violet hue; outside is a white raised border, evidently containing some fluid, and beyond this is a narrow red zone of hyperæmia. The patch may be from the size of a threepenny-piece up to that of a shilling, reaching its full development in about a week, and in mild cases goes no farther; but after remaining for a few days longer, the fluid is absorbed, the disc flattens down, and leaves only a purplish stain behind. In more severe cases a central bulla may remain, and there may be several concentric white and pink zones, separated by violet zones. The bullæ vary in size from a millet-seed to a walnut, and the patches, by coalescence, may attain considerable dimensions.

The eruption is symmetrical, though it may appear upon one side before the other; it occurs most frequently upon the extremities, especially upon the backs of the hands and arms, but may come on the face, the mucous membranes of the mouth, tongue, and eye, and in rare instances is universal, and may then be associated with hæmaturia. In another form a bulla is seen surrounded by a ring of vesicles, round which there may be a second and even a third concentric ring of vesicles, with a zone of a purplish hue between the circles. This is the form that gave rise to the term Herpes iris, but it is much less common than the other kind, though essentially of the same nature. The eruption by the evolution of fresh lesions may last three or four weeks, seldom longer, but is almost sure to recur, often at the same period in the following year; and some people have three or four attacks a year.

Erythema Nodosum is rarely seen in adults, but is not uncommon in children. The skin-lesion is often preceded by slight febrile symptoms, articular pains, and digestive disturbance. The lesions come out by two or three at a time, but seldom exceed a dozen, and are oval, nodelike swellings, from a hazel-nut to an egg in size, occurring mostly upon the arms and legs, especially over the tibia and ulna, with the long axis in the length of the limb. They appear sometimes quite suddenly, are firm at first to the touch, but soon give a semi-fluctuating sensation to the finger; but they never suppurate, and are very painful and tender. They are at first of a purplish red, but as they disappear, go through the changing tints of a bruise. The disease runs its course in from two to four weeks, and does not recur in the same way as the other exudative erythemas.

Pathology.—There are strong grounds for considering these affections to be of central vaso-motor origin, while the immediate cause of the lesion is an exudation from the blood-vessels of serum and leucocytes, and in some cases there is rupture and extravasation of blood into the inflamed tissue. In a patch of E. tuberculatum, excised from the neck, the writer found the upper part of the rete broken up, and the space filled with cell-effusion, very dense in some parts, and looser in others, as if separated by fluid; although the effusion was for the most part limited to the rete and upper part of the corium, it sometimes extended sparsely to the bottom of the corium, especially along the hair-follicles and sweat-ducts. In some places there was slight thickening of the rete, and the palisade-cells were stained with blood-colouring matter. All the phenomena of inflammation were thus present.

In Herpes iris the only difference from E. annulare or iris is that sufficient fluid is effused to make its way through the rete, and elevate the horny layer into a vesicle.

The pathology of E. nodosum is disputed; probably it is of much the same character as the others; but it has been ascribed to lymphatic inflammation, and to inflammatory infarction following embolism in the cutaneous vessels. There can be no doubt that the exudation, though usually serous, is often hæmorrhagic.

Diagnosis.—In a typical case the multiform lesions, the acute course and the special features of the lesions, as above described, and their association with articular pains, would prevent error. It is when there is only a single phase of the disease present that mistakes may arise.

E. Papulatum, coming out on the back of the wrists and upper part of the face, and attended with febrile symptoms, may give rise to a suspicion of modified variola, especially if there happens to be vesiculation superadded. The pain in the back, if any, would not be so severe as in variola, vomiting would be absent, the eruption would not appear on the third day from the onset, and would not have the shotty feel, or go on to the formation of the vesicle, pustule, and scab of variola. From measles it would be distinguished by the absence of the catarrhal symptoms, by the rash being more raised, not crescentic, and in many cases the papules would increase in size in a way those of measles never do. It differs from eczema papulatum in the large size of the papules, the duller red colour, their being convex instead of acuminate, and in the absence of severe itching. E. tuberculatum is somewhat like urticaria, but the absence of itching and burning, which is slight at the most, and the colour, which is much deeper than the pink stage of the wheal of urticaria, would certainly distinguish it. The large diffuse patches might be mistaken for erysipelas; but the symmetry and the eruption being more raised, and the constitutional symptoms not so severe, are sufficient points of difference. There can be no difficulty about herpes iris, as it is so very distinctive.

E. nodosum is also very characteristic. The lesions may, however, resemble syphilitic nodes; but they lack the hardness of the true nodes, and are symmetrical, while nodes of the tertiary period are not, and the history and other symptoms of syphilis would be absent.

The *prognosis* is good for all forms of these erythemata, and the disease rarely lasts longer than from two to four weeks. In all but E. nodosum relapses are almost sure to recur sooner or later.

Treatment.—Since the disease tends to run spontaneously a short course towards recovery, active treatment is seldom required; a saline aperient may be given, and afterwards ferruginous tonics, the perchloride acting the best; in many cases, however, the disease runs its own course uninfluenced by drugs. Guarding the patient against changes of temperature is always desirable, and when cases hang on longer than usual, precaution and rest of mind and body are absolutely necessary, and are often followed by immediate improvement. For local applications, calamine lotion, consisting of Pulv. calaminæ gr. xl., Zinci oxidi gr. xxx., Glycerini ♏xv., Aquæ rosar. f℥j., applied three or four times a day, and allowed to dry on, is sufficient, or if there is itching present, Liq. carbonis detergentis ♏x. may be added to the above lotion.

In Herpes iris a lotion of Liq. plumbi subacetatis ♏x. to Aquæ destillatæ f℥j. allays the itching and burning; but internal treatment appears to have no direct effect on the eruption; tonics are, however, often indicated in patients who are attacked with this affection, and defects in health should be carefully sought for, and, if possible, removed.

In Erythema nodosum resting the limbs in a horizontal posture is necessary, and lead lotions afford some relief sometimes, being more grateful when applied warm. Iron is often indicated after any digestive derangement has been dealt with. Be the fluctuation of the swelling ever so marked, it should never be opened, as absorption invariably takes place.

H. Radcliffe Crocker.

ESCHAROTICS. *See* Caustics.

ESMARCH'S BLOODLESS METHOD of operating has, besides reducing the mortality of major amputations, rendered easy what were previously difficult dissections. He applies an elastic bandage to the limb from the toes or fingers upwards, to beyond the site of operation, with sufficient firmness to render the limb bloodless; and where the bandage ends he encircles the limb two or three times with an elastic tube. On removing the bandage, the limb is found so bloodless that operations may be performed upon it with the same facility as upon the dead subject.

Esmarch's elastic tube is provided with a hook at one end and a chain at the other; another method of fixing the tube is to have a tape attached to each end of it, by means of which a knot may be tied, which it is easy to undo. Foulis' catch is, perhaps, the best method of securing the tube; it consists of a vulcanite pad, perforated by two holes, somewhat less in diameter than that of the elastic tube; one of them opens on the surface by a slit, and the tube is threaded through the other; the pad is placed over the artery, and after the limb has been sufficiently constricted by the elastic tube, the ends of it are pressed through the slit into the tubular catch, by which they are securely held when the traction is removed. To avoid the severe constriction of the elastic tube in long operations, an india-rubber band, wound two or three times round the limb, may be substituted for it; for this purpose, Nicaise's belt, with a hook attached to one end, and a number of eyes fixed to the bandage behind it, is a good contrivance.

Some care is required in applying the elastic tube close to the trunk, as it is liable to slip. For operations involving the upper part of the thigh, it should be wound once or twice round the limb as high up as possible, the ends crossed in front of the groin, and then carried round the pelvis and fastened over the hypogastrium. For operations on the male genital organs, it should be wound round the root of the penis and scrotum together, and fastened as above described. For amputations or excisions of the shoulder-joint, the tube should be placed beneath the axilla, and the ends drawn forcibly upwards and fixed over the acromion by a Foulis' catch; it should be held in position by a broad hook, as there is a tendency for it to slip over the point of the shoulder. Esmarch states that previous to the introduction of antiseptics he had reduced the mortality of his amputations of the leg and of the thigh from thirty-six per cent. to eight per cent.; his method is, moreover, extremely useful in dissecting operations, such as the removal of deep-seated tumours, or the extraction of splinters from the hands and feet. It facilitates the examination of diseased joints and the removal of sequestra from necrosed bones; it renders major amputations possible without skilled assistance, and the elastic tube forms a good popular tourniquet, which frequently proves most effectual in the hands of railway officials, as its use involves no anatomical knowledge.

A serious objection, which has been raised against Esmarch's method, is that it is followed by such copious oozing from the stump that the total amount of blood lost is not much lessened by it. This afterbleeding has been commonly attributed to vaso-motor paralysis; but Lister argues that this is hardly likely to occur when there is neither motor nor sensory paralysis, and states that when the more even pressure of an elastic band is substituted for the tube, it may be applied long enough to cause the afterblush without any affection of either motion or sensation. He therefrom draws the conclusion that there is a demand for blood in the tissues, and that this acts as a stimulant which causes the arterial relaxation. This explanation does not commend itself to the mind of the writer, and the more probable explanation appears to him to be, that the functional activity of the muscular fibres of the arteries is lowered on account of insufficient supply of blood, and that consequently they allow of more than usual dilatation under the pressure of the blood-stream when the bandage is removed.

Cold has been used to check this oozing, but, in America, Brown has recommended, as preferable to both cold and electricity, that the surface of the stump should be washed with hot water at a temperature of 160° F. Latterly Esmarch has adopted pressure and elevation. Before removing the tourniquet, he secures all the vessels he can find, stitches up the flaps, applies the dressing, and bandages the stump tightly; he then places the limb in an elevated position, and removes the tourniquet. By this procedure, Esmarch states that his method becomes absolutely bloodless. The free oozing after operations on bone can be easily controlled by pressure. It has been urged, on little or no evidence, that Esmarch's method favours sloughing of the flaps, and may cause paralysis or gangrene of the limb; and Weir, of New York, has credited it with a death which he attributes to overstrain of a fatty heart. It seems probable that clots might be dislodged from thrombosed veins, and foul discharges be forced into the cellular spaces and lymphatic vessels by the elastic bandage, so that it is better, in cases where either of these mishaps is possible, to substitute for it simple elevation of the limb.

Before the introduction of Esmarch's method, Lister had obtained the same bloodless condition of limbs by elevation, followed by the application of an ordinary tourniquet; and he has shown that there is another factor besides gravity which operates when the limb is raised, viz. that there is an active contraction of the arteries, which reduces their calibre to nearly that of extreme constriction. Lister's method, combined with the elastic tube, is, perhaps, the best for general application; and it is only in cases where it is desirable that the surgeon should see clearly all the parts involved, as in the removal of sequestra from bones and in deep dissections, that Esmarch's method offers special advantages. The use of an ordinary tourniquet is very advisable in amputations where the operator is short-handed of good assistants, since by it he can control the flow of blood in the arteries as he chooses. BILTON POLLARD.

ESMARCH'S INTERRUPTED SPLINT, for excision of the *Wrist*, consists of a plate of sheet iron for the palm of the hand and a tin splint for the back of the forearm, connected with one another by an iron bar which arches backwards from the front of the former to the front of the latter; the wrist is left quite exposed, and so allows of an efficient antiseptic dressing being applied. Esmarch's interrupted splint for excision of the ankle is made on the same principle.

BILTON POLLARD.

ESMARCH'S OPERATION. *See* JAWS, Closure of the.

ETHER-SPRAY.—Richardson's ether-spray apparatus has a narrow-mouthed 6-oz. bottle fitted with an india-rubber cork, pierced by two metal tubes lying close to each other. These are bent to a right angle, a short distance above the cork, so that one lies below and in front of the other. Each terminates above in a firm nozzle, that of the inferior tube being at right angles to the tube. The two nozzles are therefore at right angles, and their points are closely approximated. The anterior tube ends below almost at the bottom of the bottle, and is guarded by a fine strainer; the posterior ends just below the cork, above the ether. Through the latter tube a stream of air is kept flowing by means of a strong india-rubber ball-syringe (worked by hand or foot), and it is rendered constant by passage through a distended elastic bag, placed upon the pipe leading from the syringe to the posterior tube just above the cork.

The apparatus works as follows:—The bag is kept tensely filled with air by the intermittent working of the syringe, and forces a constant current into the posterior tube. Here the stream divides, part passing down into the bottle above the ether and forcing the fluid up the anterior tube, but the chief part, passing upwards and escaping by the superior nozzle, blows the ether issuing from the lower one into a fine spray. The rapid passage of the current of air over the lower nozzle tends to produce a vacuum in the lower tube, and this alone is sufficient to cause the ether to rise to the point.

The sulphuric ether used should be absolutely pure, of sp. gr. 0·720–0·722, i.e. it should be that which boils at the lowest temperature, volatilizes most rapidly, and therefore abstracts heat most quickly from the body. As easy tests of its suitability Richardson gives that (1) it should be neutral; (2) a drachm or two poured into the palm of the hand, warmed by breathing through it, should boil briskly, causing merely a sense of coldness; (3) blotting paper wetted with it, and laid on a warm hand, should be dry in a minute, and should retain no stain or smell.

Stanley Boyd.

EUSTACHIAN CATHETER.—This instrument is a tube rather more than six inches in length, made either of silver or vulcanite. One end is funnel-shaped, about a quarter-of-an-inch in diameter; the other is curved at an angle of 135° to the rest of the catheter for about its last inch. A ring is fixed to the side of the funnel-shaped extremity corresponding with the concavity of the curved end, and indicates the direction of the point of the catheter when it is in the naso-pharynx. Eustachian catheters are generally made of three sizes. The curve of the instrument can be altered at will to suit special cases.

EXANTHEMATOUS NECROSIS. *See* Jaws, Diseases of the.

EXCISION OF JOINTS. *See* Joints, Excision of.

EXFOLIATION. *See* Necrosis.

EXOMPHALOS. *See* Umbilical Hernia.

EXOPHTHALMIC GOÎTRE. *See* Thyroid Gland, Diseases of the.

EXOSTOSIS. — An exostosis is a limited outgrowth of bone from some of the osseous structures of the body. The diffused periosteal growth that is often left after chronic periostitis is not spoken of as an 'exostosis,' nor the osteophytic growths which occur around the joints in osteo-arthritis.

Causes.—Nothing is known for certain as to the causation of exostoses. In some cases—and these are nearly always of the multiple symmetrical variety—they are hereditary. These bony growths are of two kinds—the ivory and the spongy exostosis.

The *ivory* or hard exostosis is developed from the fibrous periosteum, and, as in the case of the bones of the skull, is due to ossification in membrane. It occurs chiefly on the flat bones, such as those of the skull, orbit, scapula, and pelvis. As its name implies, it is of very remarkable density, resembling in structure the cortical layer of bone from which it springs. It is generally single, and causes little or no inconvenience, except in rare instances when it encroaches on a cavity, such as that of the skull or orbit. An ivory exostosis growing in the frontal region of the skull may attain an enormous size, and is chiefly known by specimens in our pathological museums.

The *spongy* or cancellous exostoses occur mostly at the epiphysial lines of the long bones, are generally multiple and developed from cartilage, with a thin layer of which they are most frequently covered. When present in considerable numbers they are generally distributed symmetrically, and will be met with chiefly at the lower ends of the femora, at both extremities of the tibia, and at the upper end of the humerus. They are most frequently seen at puberty, and rarely, if ever, found after the age of twenty-five, and, with the above peculiarities, will often be found to be hereditary. They are composed of cancellous tissue, which is continuous with that of the bone on which they are situated, the cortical layer at the base of the tumour in each case being absorbed. They generally cease to grow when the growth of the bone to which they are attached is arrested. The thin cap of cartilage on the surface then ossifies, and becomes continuous with the cortical bone of the shaft upon which the tumour is placed. They sometimes, however, commence after the general growth has ceased, and then often attain considerable size, becoming large, irregularly lobulated tumours, with a comparatively small peduncle.

The *subungual* exostosis is also a spongy or cancellous bony growth, with a thin covering of cartilage. It occurs at the free border of the nail of the ungual phalanx of the great toe. It has occasionally been seen on the little toe, and a few instances are recorded on the distal phalanges of the nand. It is of some clinical importance on account of the frequency with which it is still mistaken for an ingrowing toe-nail.

The *symptoms* of an exostosis need scarcely be given in detail. It is a hard, bony outgrowth, fixed to one of the osseous structures of the body. When it occurs on the extremities and at points of pressure, a bursa is not infrequently developed on the summit, which, with the other soft structures, is projected in front of the exostosis. The secondary symptoms which these bony growths produce are entirely due to the position which they may happen to occupy. An exostosis very rarely causes any pain or discomfort, and very slowly increases in size; but when it occurs about the frontal region of the skull, and in the neighbourhood of the orbit, it may so displace the eye as to produce a hideous deformity, and at the same time destroy the eyesight.

The cancellous exostosis in the neighbourhood of a joint may also so interfere with the movements of the articulation as to considerably impair the function of the limb, or if it be situated on the inner side of the knee, on either the tibia or the femur, it may so diminish the patient's power of grasping the saddle as to effectually prevent him from riding.

As regards their diagnosis from one another, the cancellous exostoses are generally known from the position they occupy, the age at which they appear, and from their number, whilst the ivory exostosis is generally single, occurs only on the flat bones, and is seen at almost any period of life.

Treatment.—From the above account it will be seen that in most cases an exostosis should be left alone. An ivory exostosis is sometimes so hard as to defy the best instruments, and the dangers of such an operation as an attempt at its removal involves, ought not to be lightly incurred. If, therefore, these growths are producing no inconvenience and no secondary symptoms, it is better not to interfere with them. But occasionally it becomes necessary to attempt some means of relief, and the records of cases tend to prove that the thorough exposure of the base of such a growth, and the application of some mineral acid or other escharotic to the peduncular part of the exostosis, is the best and simplest means of inducing necrosis.

An inflammatory action set up at the root of an ivory exostosis seems to be a surer method of eventually removing this dense structure than an attempt by violent means to detach it from the skull by the saw or chisel. Occasionally such an exostosis has a very small peduncle, and may be easily detached; but should this not prove to be the case, it is better to try the frequent application of some escharotic than to persevere for any length of time with surgical instruments.

The cancellous exostoses generally cease to grow when the skeleton is fully developed. It is therefore unwise and unnecessary to operate in these cases, except when, from the position of the exostosis, the function of the limb is seriously impaired—as, for example, on account of its proximity to the knee-joint, the articulation which is most frequently affected in this way. Or, again, in the case of great pain and frequent neuralgia from the pressure of the exostosis upon a nerve. For these reasons, and for the deformity which it occasionally produces, an operation for its removal may have to be undertaken. In most cases the excision may be easily and quickly accomplished, the base being of soft consistence and small dimensions; in others the point of attachment being wide and of great density, the removal may involve the use of many instruments and considerable force. The operator should provide himself with different forms of cutting bone-forceps, chisels and mallet, various kinds of small saws, and a chain-saw. Sometimes the pedicle has proved, on exposure of the growth, to be formed of tough, fibrous tissue, which, on account of its shortness and strength, has allowed no perceptible mobility to the exostosis till the soft parts have been divided and the tumour completely exposed. The scalpel will, in such a case, be the only instrument necessary to complete the operation.

In using instruments close to a joint or a large vessel, the operator must be careful to work with the cutting edge directed away from the point of danger.

The subungual exostosis should be removed with the gouge or sharp spoon after an incision has been made through the soft parts round its base, so that the horny cuticle and cartilaginous cap on its summit may be taken away at the same time. If this cartilaginous cap is not removed, the growth is likely to return.

The operations are now almost invariably conducted with antiseptic precautions, but the dressings may be of dry absorbent wool (iodoform or salicylic) or of wood wool (corrosive sublimate), contained in convenient bags made from muslin which has been similarly prepared. This application may be retained for a few days, and can in most cases, after the first change of dressing, be left till the healing is complete, as the tissues generally unite by first intention.

There is now much less fear of dangerous consequences from these operations, which must, as a rule, involve the cancellous tissue of bone, than there was in former days. The dread of suppuration in the veins of the cancellous tissue led to the trial of the subcutaneous division of the neck of the growth, and also of fracture of its neck by external force without incision of the soft parts. The loose body was then daily moved to prevent its reunion. But the operation has fallen out of favour in recent years, partly because it not unfrequently failed, and partly because, with modern methods of operating and dressing, the free exposure of the bone and its section in an open wound are very rarely followed by suppuration of the medullary canal and its consequences. H. H. CLUTTON.

EXTENSION. *See* DISLOCATIONS.

EXTRACTION OF TEETH.—The roots of a great many teeth are of such a shape that, were they implanted in rigid, unyielding bone, they could not be extracted at all. The art of skilful extraction lies in a knowledge of the directions in which the bone around a normal root will best yield, and in quick recognition by the sense of touch of any alteration in this respect induced by abnormal curvatures of the roots. The blades of tooth-forceps should be thin, almost sharp-edged; they should be lightly closed upon the tooth, and then forcibly driven up so as to pass deeply between the tooth and the gum, right down to and a little within the edge of the socket. It is never necessary nor desirable to lance the gum previously, save in the case of lower wisdom teeth, to the necks of which a tough gum is sometimes strongly adherent and might be torn in the removal of the tooth. As the outer alveolar plate is much thinner, and thus more yielding, than the inner, the first movement should be inwards, so as to slightly disengage the outer portion of the root from its socket, and then much more extensively outwards, the extraction of the tooth being accomplished almost without any direct pulling. As exceptions, the four upper incisors, having cylindrical roots, may be best disengaged by rotation, and lower wisdom teeth will often move inwards more easily than outwards; their roots are often strongly curved backwards, in which case the elevator is the most appropriate instrument for their removal.

The bone of the alveolar borders is very intolerant of injury, and seems to have little recuperative power, so that the exfoliation of small fragments of the socket not rarely results, especially where unusual force has been used; an ostitis involving the whole socket and causing much pain is a less common sequela. Little can be done for these conditions save fomentation and the abundant use of disinfectants, such as Condy's fluid. *See* ALVEOLUS, Fracture of the.

Such complications are more apt to ensue when there has been, prior to the extraction, acute inflammation; but it is quite a mistake to suppose that it is desirable to wait for the subsidence of all swelling and inflammation before resorting to the extraction of the tooth; for though the healing may be slower, nevertheless it is a far shorter road to relief than to wait for the inflammation to wear itself out and then to extract—a method of practice which results in much needless suffering.

The accidents most liable to happen are the fracture of portions of the alveolus, the accidental removal of more than one tooth, the passage of a root into the antrum, its escape from the instrument down the œsophagus or the trachea, or excessive hæmorrhage. Fractured alveolus pressed back into position commonly stays there without support, and reunites; a tooth removed by mistake and promptly replaced in its socket also, in the majority of cases, refastens; a root may generally be got out of the antrum by forcible syringing, after enlargement of the opening, and the swallowing of a tooth is not likely to lead to any harmful result. A tooth is very unlikely to get through the glottis unless the patient is under an anæsthetic; of the cases on record, most have terminated by the tooth being coughed up after a longer or shorter interval, but some few cases of serious and even fatal mischief having been set up in the lung have occurred.

Hæmorrhage is best treated by mechanical means, aided by astringents; strong caustic applications, like perchloride of iron, leaving a surface not capable of speedy healing, even if they do not create fresh bleeding surfaces more difficult to control than the tooth-socket. The extracted tooth itself makes an admirable plug, or the socket may be plugged with fragments of moistened matico-leaf, and firm pressure made upon it by a roll of lint held in position by the opposing teeth. If this be carefully done it is very rare for further measures to be called for. CHARLES TOMES.

EXTRA-UTERINE FŒTATION.—This term signifies the development of a fœtus either entirely beyond the anatomical limits of the uterus, or at least away from the true uterine cavity. Cases of fœtation in one horn of a bicornute uterus, or in a pouch forming a diverticulum from the cavity of the uterus, cannot be strictly considered as belonging to this pathological condition. In a very large majority of the recorded cases of extra-uterine fœtation, the Fallopian tube was the seat of the abnormal pregnancy, and some authorities believe that nearly all the other varieties are primarily tubal. The different forms of extra-uterine fœtation or gestation are:—(1) Tubal gestation, including the tubo-uterine or 'interstitial,' tubo-ovarian, and tubo-abdominal varieties. (2) Ovarian gestation, the existence of which, in the literal sense of the term, is doubted by many pathologists. (3) Abdominal and pelvic gestation, including all cases where the ovum is entirely, or almost entirely, disconnected from the uterus, tube, or ovary. This variety may include cases where the ovum lies between the two folds of the broad ligament. Systematic writers make separate varieties out of cases where the placenta has been found in the uterus, the fœtus lying in the Fallopian tube or in the abdominal cavity, the umbilical cord passing along the tube.

The occurrence of extra-uterine fœtation has been proved by actual dissection to be associated, in many cases, with obstruction of the canal of the Fallopian tube, and consequent arrest of an impregnated ovum by mechanical agencies, such as the pressure of inflammatory bands of adhesion, kinking or extreme angular flexion of the tube from various causes, and morbid growths either within the canal or at its uterine orifice. Various sexual and menstrual irregularities have been given as causes of extra-uterine pregnancy, but seldom on satisfactory evidence. It has been alleged that excessive manual labour shortly after conception may bring about this condition. After a twin conception, it is very probable that one of the ova may obstruct the other in its passage along the tube; as, in nearly four and a half per cent. of a series of five hundred cases, extra-uterine fœtation was coincident with uterine pregnancy. It has been maintained by some authorities that the uterus is the normal seat of conception, and that spermatozoa do not naturally permeate the Fallopian tubes in women, but, on the contrary, are prevented from entering them. According to this theory, it is only when chronic morbid changes in the tubes have brought about dilatation and changes in their mucous membrane, that the passage of spermatozoa along their canals is possible, and then one of these organisms may readily encounter an ovum, and impregnate it. The fertilised ovum immediately adheres to the mucous surface with which it happens to be in contact, and tubal pregnancy is the result. Extra-uterine fœtation is most frequent in multiparæ; but, in a considerable proportion of recorded cases, the abnormal gestation had occurred either at the first pregnancy and long after marriage, or at a long interval after a previous pregnancy.

Tubal Gestation.—As the ovum passes from the ovary to the uterus through the tube, it is not surprising that it should be arrested, under some of the above-mentioned conditions, in some part of the Fallopian tube, developing, if impregnated, into a fœtus. A more or less spherical tumour is then formed in some part of the course of the tube. It contains the fœtus, and generally the placenta, but is not lined with a true decidua. In rare cases the placenta has been found in the uterus, the umbilical cord passing into the tube. After the death of the fœtus, the placenta sometimes lives and hypertrophies. The uterus almost always enlarges, probably always when the pregnancy is at all advanced; a decidua forms within its cavity, and in the few cases where it has been reported absent, it had probably been passed unnoticed. The walls of the cyst containing the fœtus are thin and tense, and tend to rupture between the third and fifth months, not half the cases carrying the child to term. The nearer the cyst lies towards the uterine end of the tube, the earlier will be the rupture. The muscular tissue in the cyst-wall probably causes partial separation of the placenta by contraction, and the consequent hæmorrhage distends the cyst till it bursts. After rupture, life may be prolonged until a second or third recurrence of hæmorrhage; or the bleeding may cease, and the patient recover.

Tubo-uterine or 'Interstitial' Gestation.—These terms are, in reality, synonymous. An ovum discovered in the uterine wall can only have been developed in the uterine portion of the tube or in a uterine pouch. On the other hand, as the calibre of that part of the tube is very narrow, it is probable that, when a fœtus develops within it, partial rupture will soon occur, so that the fœtal sac will be brought into direct relation with the uterine wall. Six specimens, described as 'interstitial' gestation, are to be found in London museums. In four out of these, the condition of the affected parts is intelligibly displayed, and in all these four the tubal origin of the 'interstitial' cyst is self-evident. A tortuous condition of the uterine portion of the Fallopian tube has been proved to be a predisposing cause of this variety of abnormal gestation. As the uterine tissue around this portion of the tube is thinner than in any other part of the uterus, rupture of a tubo-uterine cyst generally occurs very early. However, as the stimulus of gestation always causes a certain amount of hypertrophy of the uterine tissue, the walls of the sac are sometimes of considerable thickness. Although pathologically tubal, this form of abnormal gestation is, surgically, uterine; the removal of part of the cyst, or even mere incision, without wounding part of the uterus being, of necessity, impossible. As a part of the cyst bulges into the true cavity of the uterus, there is a possibility that the ovum may be discharged into the uterus, as certain clinical records would appear to prove; and should the abnormality of gestation be diagnosed, the surgeon will have the opportunity of incising the layer of uterine tissue which divides the fœtus from the uterine cavity.

TUBO-OVARIAN AND OVARIAN GESTATION. The possibility of ovarian gestation has been much disputed. A fœtal sac, which is apparently in the outer or lower part of the ovary, may very possibly be tubal; for the Fallopian tube does not naturally lie entirely above the ovary. Its outer part, including the dilated portion close to the fimbriæ, descends and bulges behind the ovary; hence the fimbriæ lie on the outer surface of that organ, the lower even reaching its inferior aspect, whilst the longest, the 'ovarian fimbria,' actually ascends the surface of the ovary, instead of descending as represented in most diagrams. When the fimbriæ are matted together from morbid changes, and the tube obstructed and dilated, it will be found that half the dilated tube coils round the outer and lower aspect of the ovary. In the same manner, when a fœtus develops within the fimbriated extremity of the tube, it forms a tumour lying external to, or even partly below, the ovary, and often encroaches on ovarian tissue. Many observers, not cognisant of the above fact, have taken tubo-ovarian for ovarian pregnancy. The writer once dissected the uterus and appendages in a case where a patient had died from rupture of an extra-uterine cyst, the existence of which had been unsuspected during life, amenorrhœa having existed for a year, and the cyst having felt like a multilocular ovarian tumour. The ovarian ligament appeared to run from the uterus to the inner surface of the cyst; a cardinal proof, in most cases, that a tumour springing from the uterine appendages is truly ovarian. But on dissection it was found that the tissue on which the ovarian ligament ran was a small and distinct ovary, squeezed flat between the uterus and the cyst, to which it was soldered by adhesions. The cyst was distinctly tubal. This squeezing up of the ovary may be seen in early stages of tubal gestation. Hence the writer is compelled to distrust the evidence of several authorities as to the occurrence of cases of ovarian pregnancy in their practice, based on the fact that the ovarian ligament ran on the surface of the cyst. Tubo-ovarian pregnancy signifies gestation in the outermost part of the tube, and in this variety the tissue of the ovary is rapidly encroached upon by the sac.

ABDOMINAL GESTATION.—It has been doubted whether an ovum can drop out of the Fallopian tube after impregnation, and fall into the peritoneal cavity; and it is not certain that an unimpregnated ovum can be fertilised after straying on to the peritoneum, although it has been stated, upon good authority, that spermatozoa have been found on the surface of that serous membrane near the uterus, and that, in tubal pregnancy of one side, the corpus luteum corresponding in its degree of development to the abnormal pregnancy has been found in the opposite ovary. The great majority of cases of abdominal gestation arise from rupture of a tubal cyst. True pelvic or broad-ligament gestation must be included in this category. Rupture of the tube along its free surface is, as a rule, followed by hæmorrhage and death of the fœtus at least; whilst, should the fœtal cyst be rent between the two layers of the broad ligament as they pass under the tube, the embryo might readily escape into the cellular tissue of the ligament, which would offer resistance to hæmorrhage. Its life might then be spared, and it would develop in its new cavity, forming a tumour that would soon become partly abdominal. Should the fœtus survive rupture of the tube along its free surface, true abdominal gestation would occur. The placenta in these cases is sometimes found adherent to some of the abdominal viscera. When it becomes attached to the serous coat of the intestine, the mucous membrane of the latter tends to become congested; and if the fœtus should die, the placental vessels may convey septic material from the intestines to the fœtal tissues. Hence, as Freund has pointed out, diarrhœa or dysentery followed by symptoms of septicæmia in cases of extra-uterine pregnancy, affords strong evidence that the placenta is adherent to intestine.

Symptoms and Diagnosis.—The existence of extra-uterine pregnancy has been repeatedly diagnosed before rupture of the cyst, but in many cases the symptoms have misled the most experienced authorities. In the earlier stages, it is the pregnancy that is most in evidence; in the later, the tumour. When a woman believes herself to be pregnant, or has ceased to menstruate for two or three months, and suffers from crampy or colicky pains in the hypogastrium, or in one iliac fossa, pains of marked severity, and more or less paroxysmal, there is always good reason to suspect extra-uterine pregnancy, especially if the woman has never been pregnant before, or not for many years. If there be characteristic changes in the breasts, with discolouration of the vulva, enlargement and partial displacement of the uterus, and the formation of a tumour which can be detected above the pubes, or on one side of Douglas's pouch, the diagnosis of extra-uterine pregnancy will be all but certain. Subsequent symptoms of abortion, with the discharge of a decidua, but no ovum, will be of grave import in such a case, being the harbinger of rupture of the cyst. If the abnormal pregnancy be advanced, a soft tumour, resembling a pregnant uterus, may generally be detected in the abdomen, the uterus being found on vaginal examination to be more or less enlarged, but separate from the tumour. Should a so-called 'placental' souffle, and, above all, the fœtal heart-sounds, be heard on auscultation over the tumour, the nature of the case will be very evident. Active fœtal movements, perceptible through the abdominal walls, do not, in themselves, constitute an important proof of extra-uterine pregnancy, as they are usually observed in normal gestation when the patient's abdominal walls are thin. Rupture of the cyst gives rise to severe pain, collapse, and all the symptoms of intra-abdominal hæmorrhage. It may, in rare cases, cause instantaneous death; more frequently the patient rallies for a few hours or days, and sinks under a return of the symptoms. Schröder and Freund have shown that spontaneous recovery is not so infrequent as was once supposed. In cases of fatal rupture of the cyst, murder or suicide, especially by poison, may be suspected when the true nature of the patient's case has been overlooked; but the real character of the accident may be proved with facility by a carefully conducted necropsy.

On the other hand, many of the above important symptoms may be masked or absent. Menstruation had ceased, in one case under the writer's observation, for twelve months before fatal rupture of a tubal cyst; and it has in several cases persisted—as in one instance where rupture occurred during coition, in a patient who was suckling, and in whom the catamenia had not been suppressed during lactation, the last period having ceased two days before the accident. Occasional hæmorrhage from the uterus is frequent during extra-uterine gestation, and has been mistaken for menstruation. The death of an extra-uterine fœtus at term causes symptoms of what is known as missed labour. When such symptoms as labour-pains and hæmorrhage from the uterus, with no subsequent expulsion of a fœtus, are observed, it must be remembered that retention of a dead fœtus in the uterus after term is not proven, whilst the retention of a dead extra-uterine fœtus in the abdominal cavity for months or years has been repeatedly observed.

The colicky pains are sometimes absent, especially in the abdominal and tubo-ovarian varieties of abnormal gestation; they are also met with in certain chronic uterine and ovarian affections. The changes in the breasts and vulva may be obscure or absent in the earlier stages of extra-uterine, as in the same periods of normal pregnancy. In several cases, of which accurate clinical records exist, the uterus was not enlarged, and was but little, if at all, displaced. The fœtal cyst is not always easy to detect, especially in stout subjects. In true abortion the ovum may escape undetected, and the presence of an enlarged ovary may mislead the practitioner. The tumour, when large, may readily be taken for an ovarian or a uterine growth, especially if the fœtus be dead, so that the souffle and heart-sounds are absent, and if the other physical signs of pregnancy be wanting. The co-existence of extra-uterine fœtation and abdominal or pelvic tumour, may greatly increase the difficulties of diagnosis. A souffle is occasionally heard in large soft uterine fibroids. In one case, an abdominal tumour and a gravid uterus were detected in the same patient. Fœtal heart-sounds could be heard on auscultation of the uterus, but not when the stethoscope was applied to the tumour. The ultimate course of the case showed that twin pregnancy had occurred, the extra-uterine fœtus having died.

Rupture of the cyst produces pelvic hæmatocele in cases where the patient survives the accident for a few days; in one case, at least, a hæmatocele formed through another cause whilst tubal pregnancy existed. The absence of coma and dyspnœa distinguishes the symptoms of hæmorrhage after rupture of the cyst from intracranial and intrathoracic hæmorrhage, but its distinction from intra-abdominal hæmorrhage, due to other causes, will depend on a careful consideration of the history of each individual case, and is often impossible. Lastly, the symptoms produced by the retention of an extra-uterine fœtus beyond term are often very puzzling; there must of necessity be an abdominal tumour; and if the contents be discharged through a communication with the intestine, bladder, vagina, or abdominal wall, portions of the fœtus will be recognised. When, however, the fœtus has undergone degenerative changes, with simultaneous atrophy of the placenta, the tumour may resemble a uterine fibroid growth, a dermoid ovarian cyst, or even a malignant tumour of the omentum or abdominal viscera. A calcified fibroid tumour and a 'lithopædion' closely resemble each other to the touch. Here again, the surgeon must rely as much upon history as upon physical signs.

Treatment.—Extra-uterine fœtation is a very grave affection. Rupture of the cyst at or after the third month is the most frequent termination of the case; and this accident, though not so surely fatal as was once supposed, very frequently causes the patient's death. If the patient survive the full term, she must incur numerous risks through the presence of a dead fœtus in the abdominal cavity. Diagnosis is not always easy, as has been explained; but a simple exploratory incision through the abdominal walls—an operation which experience has shown to be almost free from risk when antiseptically performed—will prove the nature of the case; and it must be remembered that many diseases which have been taken for extra-uterine fœtation are equally or still more suitable for operative measures. Before speaking of the radical cure of this affection by removal of the fœtus through an abdominal incision, it must in the first place be observed that, when abnormal gestation of this class is suspected, the patient must be kept at rest as much as possible. To allay the crampy pains, opiates, especially hypodermic injections of morphia, are of high value. Inhalations of chloroform are not advisable, as the struggling before anæsthetisation, and the frequent vomiting afterwards, might cause rupture of the cyst. An abdominal belt, light diet, and a regular daily action of the bowels, are further requisites in cases of this kind. It is certain that these palliative measures have sometimes saved the patient, if we may trust the diagnostic powers of several obstetricians, the fœtus perishing early in the pregnancy and its sac shrivelling up.

Incomplete operative measures cannot be said to have yielded a favourable series of results, although all have saved life in a few cases. Among these measures are—killing the embryo by strong electric shocks or galvano-puncture, injections of narcotics into the cyst, puncture of the cyst in order to destroy the embryo by drawing off the liquor amnii, and removal of the embryo by section of the vagina with the galvanic cautery. This last operation is neither easy nor safe; it is done in a region which cannot be thoroughly exposed to light, and where manipulation is very difficult. A powerful electric shock, sufficient to cause the death of an adult by its stimulation of the inhibitory fibres of the pneumogastric nerve, might have little or no effect on a fœtus, which has no inhibitory apparatus. This form of electricity has, moreover, often proved a failure in recorded cases. Electrolysis has also failed in its object; in one case the fœtus survived its influence after tapping and morphia injections had been tried for the same purpose. A fœtus has survived the injection of two grains of morphia. Drawing off the liquor amnii is still recommended by distinguished authorities; it is not a difficult proceeding, but does not always kill the fœtus, however completely the fluid be removed, and it not unfrequently results in the death of the patient by hæmorrhage or septicæmia. If the fœtus be killed by any of the above methods, its remains will probably be discharged through fistulous communications between the sac and the rectum or vagina, during which tedious process the patient will be seriously invalided.

The removal of the fœtus by an abdominal incision is an operation which is yearly growing into greater favour, as the true course to be pursued when extra-uterine gestation is diagnosed. To expose a Fallopian tube ruptured at an early stage of extra-uterine fœtation, to clear out the clots and fluid blood with which the peritoneal cavity is filled, and to remove the tube and its embryo-bearing sac, after ligature of the uterine appendages as in ovariotomy, is an operation of great difficulty; yet it is advocated by, and has been successfully performed by, Mr. Lawson Tait. When an unruptured cyst, in a late stage of pregnancy, is exposed by an abdominal incision, the operation is not so arduous; besides, the patient is, as a rule, in a less desperate condition. The abdominal wound must be made as in ovariotomy, and the sac opened cautiously, as the placenta is sometimes attached to its front surface. The sac should then be stitched to the margin of the wound, incised, and a small portion of its wall removed. The fœtus must then be extracted, and the umbilical cord divided. During these manipulations care must be taken not to disturb the placenta. The sac must then be well washed out with antiseptics, and a drainage-tube should be passed into it as deeply as possible; it must also be packed with antiseptic dressing. The placenta will come away in a short time, and the wound, after daily antiseptic washing and packing, may be closed when blood and broken-down tissue cease to issue from the tube. The operation has been successfully performed, both before term, and in cases where the fœtus had been retained for months beyond the normal period of gestation. The operator should not attempt to remove the cyst itself, as its precise nature, and its connection with other parts by adhesions, cannot always be ascertained by abdominal section, and when left behind and drained it atrophies, and causes no inconvenience to the patient.

In cases where the bones of an extra-uterine fœtus are discharged through a fistulous opening in the rectum, vagina, or abdominal wall, it may be necessary to enlarge the opening and thoroughly empty the contents of the abnormal cavity, employing antiseptic solutions and drainage. The cavity must be explored and syringed out with great care, lest any adhesions be disturbed.

Tubo-uterine or 'interstitial' pregnancy is not easily diagnosed; if it be detected during abdominal section, it is difficult to advise any other course than amputation of the uterus above the cervix. If diagnosed before operation by dilatation of the os uteri, the method already suggested in the paragraph on tubo-uterine gestation might be practised, as involving less risk than hysterectomy.

Alban Doran.

EXTRAVASATION OF URINE.—The escape of urine from the urethra through rupture of the wall of the passage. This rupture is occasionally produced by accidental injuries, such as falls or blows on the perineum, which tear open the urethra in that situation. A more common cause is yielding of the urethra behind a stricture, which has long obstructed the flow of urine and gradually dilated the portion behind the contraction until complete, or almost complete, retention takes place. The weak expanded portion may give way suddenly during a violent effort to expel urine. In this case the patient feels a momentarily sharp, stinging pain, and then for a little while relief from the urgent call to void urine, through some of the contents of the bladder escaping into the cellular tissue around the urethra.

A more frequent mode is for the urine to penetrate into a small abscess that has formed in a follicle of the expanded urethra. In this case the escape of the urine is slow and limited to the track of the abscess, which then passes forwards and forms some variety of perineal abscess, ultimately reaching the surface of the body and opening a fistula for the escape of the urine from the urethra behind the stricture. Such gradual and limited escape, though a grave affection, is attended with far less constitutional disturbance and danger than the acute form, with extensive infiltration of urine into the cellular tissue.

If the extravasation is suddenly produced during violent straining, the urethra has given way at the membranous portion between the two layers of the triangular ligament (deep perineal fascia), where it is but little supported by the surrounding structures. The urine rapidly perforates through the anterior layer of the triangular ligament into the cellular tissue of the scrotum and penis, and thence beneath the integuments of the belly—sometimes as high as the nipple. The attachments of the deeper layer of the superficial fascia to the borders of the triangular ligament, to the rami of the pubes, and to Poupart's ligament as far as the crest of the ilium, prevent the urine from wandering down the thighs or backwards to the perineum. Occasionally the sloughing which follows this soaking in unhealthy urine causes the attachment of the superficial fascia to the triangular ligament to give way, when urine spreads to the ischio-rectal fossæ between the layers of the pelvic connective tissue, causing extensive sloughing of the nates and, if the patient survive, fistulæ around the rectum and beneath the glutei muscles.

The local effects of the sudden escape of urine which has become decomposed by long retention in an unhealthy bladder are very destructive; gangrenous inflammation is excited wherever it reaches. The swelling spreads rapidly in the directions named, the skin grows dull red, brawny, or boggy, crackling, or even emphysematous. The skin sloughs over the scrotum, penis, and lower part of the abdomen, and exposes fœtid, dark-coloured layers of sphacelated cellular tissue soaked with urine and serum.

The constitutional effects are often very great and always serious. The patient is never in a healthy condition before the rupture of the urethra, and is quickly and greatly prostrated. He is anxious, restless, and in considerable pain. The pulse is rapid, small, and easily compressed, the tongue dry and brown along the middle. These symptoms are followed by wandering delirium, insensibility, increasing general prostration, and in many cases death. Should the patient survive, and this is more probable if the skin sloughs rapidly, thereby affording vent speedily to the pent-up putrid urine and so limiting the area of its infiltration, recovery is sometimes very rapid. The sloughs are thrown off, healthy granulations succeed them, and the exposed parts, testes, corpora cavernosa, or abdominal aponeuroses, are quickly covered with sound scars, while the urine escapes through one or more fistulæ at the lower part of the scrotum.

The immediate *treatment* of this affection consists in setting free the pent-up urine, establishing a short course for the urine from the bladder to the surface, and in maintaining the patient's strength by means of nourishing and stimulant diet.

As soon as indications of extravasation are given, the patient should be anæsthetised and put into the lithotomy position. Then, the left forefinger being kept in the rectum to draw it away from the knife, a sharp-pointed bistoury should be pushed directly backwards, one inch in front of the anus in the raphé of the perineum until the dilated urethra is reached. A Wheelhouse's small tapering gorget can then be passed through the wound along the posterior part of the urethra to the bladder, and by its means a catheter may be guided thither, when the catheter should be tied in, and the urine allowed to drain off continuously from the bladder. The further extravasation of urine being prevented, the liberation of that which has already percolated into the cellular tissue must be obtained by several free incisions of the brawny swollen areas as far as they have reached, and made in the scrotum and penis on each side of the mesial line. The division of the stricture which has caused the extravasation may be carried out at the same time: more commonly, however, it must be left until the patient has regained some of his strength. When the stricture is too narrow or too tortuous for a staff to be passed through it, it is better to delay the treatment of the stricture till the patient have recovered from the extravasation. But if the patient have a moderate amount of strength, and the extravasation be not extensive, and if a guide staff can be carried through it to the bladder, the stricture can be dealt with at once. This is done, after the perineal incision has given access to the bladder, by passing a Syme's shouldered staff through the anterior portion of the urethra and the stricture until its beak reaches the left forefinger placed in the posterior part of the urethra. An assistant then holds the Syme's staff steadily in the perineum, while the operator, using his left forefinger as a guide, cuts the urethra from behind the stricture forward to the shoulder of the staff along its groove. The rigid instrument is then withdrawn, and a flexible catheter passed on to the bladder with the aid of the tapering gorget if needful, and tied in for a few days after the operation.

In addition to the primary treatment by perineal and other incisions, the sloughy parts should be dressed with warm wet boracic lint or with lint soaked in carbolic oil 1 in 10 or 1 in 15; the sloughy surfaces freely dusted with iodoform, and the whole covered with tarred hemp wrung out of hot water. If the patient's strength permit, he can be most thoroughly washed in a hip-bath of warm, weak solution of Condy's fluid or other antiseptic, in which also the sloughs can usually be most easily removed. The patient will need from the first bark, opium, brandy, and strong beef-tea, or any other nourishment he can take, to enable him to withstand the exhaustion that follows the sloughing of the cellular tissue and skin.

Berkeley Hill.

EXTROVERSION OF BLADDER.

See Ectopia Vesicæ.

EYE, General Examination of the.—The more important diseases to which the eye is liable will be made the subject of separate articles under appropriate headings; and all that will be attempted in this place is to give a general view of the chief symptoms by which ocular maladies declare themselves. The transparency of many of the tissues of which the eye is composed, and the accessibility of most of them to various modes of examination, render it easy, in the majority of cases, to ascertain the precise facts with regard to any form of ocular disease or injury. It is therefore the more necessary to utilise in the most complete manner the advantages afforded by the structure and position of the organ, and to look at it in such a way, and with such attention, that nothing which exists can escape notice. Occasional errors of inference and interpretation are, perhaps, inevitable; but an error about a matter of fact can seldom arise excepting from haste or carelessness. There are many advantages in following a settled order of investigation, and it will usually be best to proceed from the superficial to the deeper textures.

The *eyelids* will thus come first under observation, and they may depart from the healthy state in many ways; by faulty position, by swelling, by redness, or by the condition of their margins or appendages. *See* Eyelids. Whenever there is any redness or irritation of the surface of the eyeball, it is not enough to notice the absence of coarse eyelid changes, but the state of the margins and of the cilia should be carefully scrutinised. For this purpose it is well to use a magnifying glass, and to look closely at the growth and position of the cilia, moving the eyelid a little way from the globe during the examination, so as to let the light fall at different angles from time to time. In this way fine semitransparent ingrowing eyelashes may be discovered, or sometimes a detached eyelash which has been carried into one of the lacrymal puncta and arrested there. The margins of the upper lids should be scrutinised in similar fashion, as well as the whole surface of the conjunctiva, both palpebral and ocular.

In order to examine the conjunctiva of the lower lid, the lid should be drawn down by the tips of one or two fingers, placed on the skin just above the inferior margin of the orbit. The patient should then look upwards as much as possible, and the lower retro-tarsal fold will be thrown forward and rendered prominent. In some persons a good view of the lower part of the conjunctival sac may be obtained by drawing the lower lid forward while the eye looks down. In order to see the conjunctiva of the upper lid, a somewhat less simple manœuvre is required. The lids being gently closed, the surgeon takes any slender instrument, such as a probe or a knitting-needle, and places it horizontally along the upper lid, just below the upper level of the tarsal cartilage. A slight pressure against the upper part of the cartilage inclines its lower margin a little forward, and this margin is then seized between the thumb and index finger of the disengaged hand, which obtain a light but firm hold of the cilia and the edge of the lid. The surgeon draws the lower part of the eyelid still more forward, and then with a quick movement turns it upwards round the probe, which is held immovable and acts as a fulcrum of rotation. At the moment when the upward turn is given to the lid, the patient, if not already doing so, should be told to look down, and complete eversion will be obtained.

The lid being everted, its inner surface must be examined; and it must be borne in mind that foreign bodies are especially apt to lodge on this surface, about a line from the margin. The upper *cul-de-sac* does not admit of being completely exposed, although, when the patient looks down, most of it may be brought into view. It is a not uncommon place of retreat for a certain class of foreign bodies, such as fragments of straw, or of the awn of barley; and it may be fully explored by the bent portion of a hair-pin or by a loop of wire. Eversion of the upper lid is not agreeable, and need only be practised when the history of the case, or the appearance of the ocular surface, points to the probability of some irritant being concealed beneath. Besides foreign bodies, such an irritant may be supplied by warty granulations of the palpebral conjunctiva, which are residual to chronic conjunctivitis, and are frequent causes of undue vascular development on the cornea, especially on its upper portion; while in the lower retro-tarsal fold we may find granulations of another kind—the so-called 'sago grains,' which consist mainly of aggregations of lymph-cells.

Conjunctiva and Sclerotic.—Obvious congestion of the ocular surface may be limited to the conjunctiva, or may extend to the deeper portions of the globe. Active congestion of the conjunctiva is readily produced by trivial causes, and, if these continue in operation, the congestion soon becomes chronic, from passive dilatation and loss of tone of the vessels. It may vary in degree, from a mere vascular network, with white interstices, to the production of uniform redness. Congestion limited to the conjunctiva may be distinguished by the readiness by which the vessels may be momentarily emptied by pressure. If the tip of the index finger is placed against the cutaneous surface of the lower lid, and so used as first to raise the lid a little towards the cornea and then to make it glide down again over the lower part of the eyeball, the track of digital pressure, if the congestion is only conjunctival, will for an instant be left purely white, quite up to the corneal margin. The vessels refill as the finger passes on, and obliterate its track. But if the congestion reaches deeper parts, as will happen in cases of inflammation of the iris, cornea, or ciliary body, it will involve the fine vascular zone of the sclera, which surrounds the corneal margin, and which remains unaffected by pressure. The vessels of this zone are too small to be individually visible, even when overfilled; but their distension forms around the cornea a pink annulus, which is sometimes seen through the conjunctival vascularity, and is sometimes obscured by it, but which may always be brought to light by the effect of pressure, which then leaves a track that is pink near the cornea, and becomes white at some little distance from its margin. There is yet a third form of congestion, which is passive and subconjunctival, and is dependent upon some impediment to the free exit of venous blood from the interior of the eye. In this form the surface of the sclerotic is traversed by distended and tortuous veins, full of dark-coloured blood, which may be seen to emerge from the eyeball through openings not very distant from the corneal margin, and to pursue their course backwards. They are chiefly met with in cases of chronic internal inflammation or of increased tension, and are constantly present in fully developed glaucoma. *See* CONJUNCTIVA.

Cornea.—The chief characteristics of the cornea are its uniform transparency and its smooth reflecting surface, which, as a convex mirror, affords an erect but diminutive image of the objects in front of it. In the healthy state, the transparency of the cornea allows us to see the fibrillation and the colours of the iris with perfect distinctness; but it does not follow, because these are concealed, or seen only imperfectly, that the transparency of the cornea is impaired. The iris may be veiled by turbidity of the aqueous humour, due to the presence of blood or of inflammatory products in the anterior chamber; and we then judge of the condition of the cornea by its smoothness and reflecting power, and by the presence or absence of vessels running upon it from the conjunctiva. On the other hand, when the cornea itself is turbid, the turbidity is at first seldom uniform over the whole surface, and the more transparent portions will often allow us to see the condition of the aqueous humour and iris.

Slight opacities of the cornea, and even foreign bodies, such as pieces of coal or iron, embedded in its surface, are liable to escape cursory observation by reason of the direction in which the light falls upon them, or because they resemble in colour the background of iris or pupil behind them. In order to obtain the best possible view of the cornea, the patient should be seated opposite a large window admitting plenty of daylight, but not exposed to the direct rays of the sun. The eye under inspection should not only be turned successively in various directions, but the surgeon should also vary his own point of view, and, in cases admitting of any doubt, should employ two convex lenses—one as a 'bull's-eye,' to concentrate light upon the parts observed, the other as a magnifier, with which to examine the illuminated surface. The same thing may often be advantageously done by lamplight, and is then called 'focal illumination.' Inspection of the cornea may show that some foreign body is embedded in it, or that its surface is more or less cloudy, or irregular in shape, or ulcerated, or marked by the cicatrices of former ulcers. It may also be the seat of circumscribed abscess, or of suppuration between its laminæ, or it may be traversed by blood-vessels, arranged sometimes as two crescents, encroaching upon its upper and lower margins, sometimes in a fasciculus running to some single point, sometimes distributed more or less evenly over its surface. All these are conditions to be carefully noted as elements in diagnosis and as guides to treatment.

Aqueous Humour.—The parts which come next under examination are the aqueous humour, the iris, the pupil, and the portion of the crystalline lens lying immediately behind it. In health, the aqueous humour is perfectly transparent; but it may be rendered turbid by the presence of early inflammatory products, of pus, or of blood. Inflammatory products may be evenly diffused throughout the fluid; but pus and blood, unless they fill the anterior chamber completely, will tend to gravitate towards its lower portion. In this position, pus may be mistaken for a purulent infiltration between the layers of the cornea itself; but such an error would usually imply a careless inspection. The upper boundary of an infiltration is, as a rule, irregular; while that of a collection of pus, unless so small in quantity as to be rendered crescentic by cohesion to the angle between the cornea and the iris, forms an even horizontal line, which may change its position when the head is laterally inclined.

Iris and Pupil.—When the cornea and the aqueous humour are both transparent, they allow the condition of the iris and pupil to be clearly seen. The chief characteristic of the healthy iris is its lustrous striated surface; the chief characteristics of the healthy pupil are its circular outline and its free mobility. If the iris be dull or discoloured, or if the pupil be irregular in shape, or contracted, or sluggish, these are facts on which important inferences may be founded. The lustre of the iris speaks for itself, but the determination of the mobility of the pupil requires care and attention. A sluggish pupil will still dilate and contract in unison with its healthy fellow, although not to the same extent; and hence it is necessary to protect from variations of light the eye which is not being examined. For this purpose, it should be closed, and the closed lids should be covered by a towel or handkerchief, folded into a sufficient number of layers to exclude light entirely, and then applied gently but closely by the hand. The eye under examination should not be touched, but only shaded by the hand of the surgeon, so placed as to intercept light as much as possible, and then once and again quickly moved aside while the pupil is steadily watched. In a healthy eye so treated, the pupil rather slowly dilates under the shadow of the hand, and contracts much more quickly when the shadow is withdrawn. Before concluding the inspection, it is proper to direct the patient to turn the gaze alternately to some near and to some distant object; because, in the healthy state, the pupil contracts during the effort of accommodation, and dilates again, independently of illumination, as the accommodation effort is relaxed. In certain diseases of the nervous centres, this function is perverted; and the pupil which varies under light may be stationary during accommodation, or *vice versâ.* In all cases the pupil should retain a circular outline while changing; and its area, up to about the age of fifty, should be of a clear bright black. After fifty, the black is usually exchanged for a more or less grey or yellowish tint.

Under the influence of disease the iris may be dull, or visibly vascular, or studded by nodules of lymph; and the pupil may be sluggish, or altogether fixed, or irregular in outline, contracting and dilating only at certain parts of its circumference, and its area may be more or less occupied by inflammatory products. For the full determination of some of these conditions, and also in order to inspect the crystalline lens, it is often necessary to obtain dilatation of the pupil by the aid of a mydriatic; and for the purpose of mere examination, the best which can be used is a solution containing one per cent. of homatropia hydrobromate in distilled water. The advantage of this preparation is that its action passes away within twenty-four hours, and hence does not entail the same degree of inconvenience as an application of atropia or of duboisia. A single drop of the solution, placed within the lower lid by means of a quill or a camel's-hair pencil, will usually produce dilatation in from twenty to thirty minutes; and any adhesions or irregularities of outline will then be rendered conspicuous. When the pupil dilates completely, or with a near approach to completeness, it becomes possible, by the aid of focal illumination, to see deeply into the crystalline lens, and even to recognise morbid growths, or effusions of blood or lymph, lying behind it in the vitreous.

Crystalline Lens.—Opacities of the lens may generally be made out very clearly, their grey or brown colour contrasting with the natural aspect of the pupil. For the inspection of parts deeper than the iris, focal illumination is at best a method supplementary to the use of the ophthalmoscope, an instrument which is in most cases essential to a complete examination, and which will be the subject of a separate article. *See* OPHTHALMOSCOPY. But without the ophthalmoscope it is possible for anyone, who is acquainted with the anatomy of the eye and with the elements of pathology, to discover, by careful looking and by the exercise of common sense, what is the actual condition of all the more superficial parts of the organ. *See* CATARACT; CRYSTALLINE LENS.

In order to examine these superficial parts completely, it is important that the patient should be able to assist the surgeon, not only by opening the eyes freely, but also by turning them in any required direction. There are some cases in which there is so much intolerance of light that the eyes can scarcely be opened at all, and in these it is necessary to resort to special expedients. A patient of sufficient age can often show the cornea by first directing the eyes towards the ground, and keeping them fixed in that direction, while the surgeon gently lifts the upper lid. With a child, if the difficulty arises as much from fear and unwillingness as from photophobia, the little patient may be made to sit on the knees of a seated attendant, and with his back turned to the surgeon, who must also be seated. The surgeon then lowers the child's body to a horizontal position, with the face upwards, and fixes the head firmly between his knees, while the attendant restrains the arms and legs. If the eyelids cannot then be sufficiently separated by the fingers, a metallic retractor may be slipped beneath the upper lid; and, if the eyeball is rolled upwards by the superior rectus, so as to conceal the cornea, a little chloroform may be administered. It is almost always better to have recourse to this expedient than to permit the nature of the affection to remain in doubt.

Tension of Eyeball.—In addition to the most careful inspection possible, it is often necessary to ascertain by palpation the degree of tension of the eyeball; since this is often of high importance and is liable to vary greatly in many diseased conditions. In order to estimate tension, the patient should be told to look downwards, closing the eyelids gently; and the surgeon should place the tips of his two forefingers just under the upper margin of the orbit, so that, through the intervening lid, they may rest upon the deepest part of the globe which is accessible. One fingertip is then employed to steady the eye, while the other, by a gentle counter-pressure exerted and relaxed alternately, ascertains the degree of hardness. Under this manipulation, a healthy eye is felt to dimple a little, with a peculiar elastic resistance which is difficult to describe, but which the sense of touch soon learns to recognise, and for which the observer may usually take one of his own eyes as an approximate standard. The thinness, and consequently greater elasticity, of the sclera in children, in women, and in delicate persons generally, renders their eyes less resisting than those of adults, of men, and of the robust; and a certain degree of hardening is not unnatural in old age. Beyond the physiological limits tension may vary from a condition in which the eyeball is quite soft, so that its shape may be visibly altered by pressure, to a condition in which it feels as hard as stone. Such extremes are at once recognisable; and differences of opinion can arise only with regard to intermediate conditions. In cases which occasion doubt, it may be remembered that, as a general rule, the tension of the two eyes of the same individual will be alike originally, unless there is a congenital difference of refraction between them; and that abnormality of tension seldom proceeds with equal steps in both. A difference between the two eyes, therefore (and a very small difference may be recognised), should always be regarded with suspicion, and should at least lead to careful and repeated examination. Increased tension is generally associated with diminished acuity of vision (*see* VISUAL ACUITY), and also with contraction or modification of the field (*see* PERIMETRY), as well as by some displacement of the plane of the iris, by some sluggishness and often by dilatation of the pupil, and by diminished sensitiveness of the surface of the cornea. All these points will be fully discussed under the article GLAUCOMA, which see.

The diseases of the interior of the eyeball include those of the iris, of the crystalline lens, of the ciliary body and choroid, of the vitreous body, and of the optic disc and retina, all of which will be the subjects of special articles. For many of them, *see also* OPHTHALMOSCOPY.

PANOPHTHALMITIS.—The eyeball is liable to become the seat of general inflammation in various conditions of disease or injury. General inflammation, leading on, almost invariably, to suppuration, was a not very uncommon consequence of the method of cataract-extraction by the 'flap' operation, which has now fallen into disuse, and such inflammation is seldom seen after the employment of the more modern methods of procedure. It may follow any severe injury, either a contusion or a wound or rupture of the globe, and it is an occasional consequence of general pyæmic infection. The only treatment required, generally speaking, is to relieve painful distension by free incisions through the sclera, and, if the pain be not severe, nothing need be done beyond the use of such fomentations, or other soothing applications, as may be agreeable to the feelings of the patient. Inflammation of the eyeball, apart from the conditions in which it may originate, is seldom dangerous to life, although cases are recorded in which it has led to fatal meningitis, and, therefore, when an eye has been so severely injured that general inflammation may be expected, it is often desirable to perform enucleation early —to perform, in short, a primary amputation of the damaged organ, and thus to avoid suffering and danger. An eye should never be removed when in a state of actual or manifestly impending suppuration; and, after suppuration is completed, its removal is seldom necessary. The shrunken globe which is left behind often forms an excellent stump for an artificial eye, and seems to have no tendency to excite sympathetic mischief. On this account, Von Graefe proposed to excite suppuration artificially as a substitute for enucleation, by passing a seton through the eyeball in cases in which the conditions were such as to render sympathetic ophthalmitis probable.

The symptoms of panophthalmitis are scarcely liable to be mistaken. In the course of pyæmic infection, or after an injury, the eyeball becomes tense and hard, the lids and conjunctiva swollen, and vision is early abolished. If the cornea retains its transparency, pus may often be seen upon the iris, or in the pupil. In traumatic cases the pain is generally severe, but in those which originate in pyæmia it is little complained of. When pus or inflammatory products obtain a free outlet, either by perforation or by incision, the pain soon ceases, and, at the same time, the eyeball becomes soft, and the lid-swelling gradually subsides.

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EYEBALL, Excision of the.—Enucleation of the eyeball may be required on account of injury, especially to the ciliary body, or on account of the presence of a morbid growth. When the tunics of the eye are entire the operation is extremely simple, and the writer prefers what is called the 'Vienna method' of performing it. The patient being placed under an anæsthetic, a spring speculum is inserted between the lids and opened rather widely. The surgeon incises the conjunctiva, passes a strabismus-hook beneath the tendon of the internal rectus, and divides it, with the conjunctiva, at its insertion into the sclera. Seizing the stump of the tendon with forceps, he rotates the globe outwards, and, with scissors somewhat curved on the flat, divides the optic nerve. One blade of the scissors is then kept close to the eyeball within the wound, the other being external, and the blades are made to inclose and divide, at one stroke, the superior or inferior rectus with the conjunctiva covering it. The opposite muscle is divided in a similar manner, and the eyeball is lifted out of the orbit, a last touch of the scissors separating the external rectus, and any other tissues which may remain undivided. A pad of sponge should be instantly applied over the closed lids, and retained by a firmly-applied bandage, so as to compress the skin against the margin of the orbit, and to prevent leakage of blood into the subcutaneous tissue of the face. Unless this is carefully done, there is apt to be much temporary disfigurement from ecchymosis. After about four hours the tight bandage may be removed, and the subsequent dressing will only be to afford protection and to secure cleanliness. The muscles will fall together into a stump, and the wound will heal without trouble or delay. An artificial eye may be introduced in a fortnight or three weeks after the operation.

Another, but less expeditious method, is first to divide the conjunctiva just beyond the corneal circumference, then each of the four recti muscles separately on a strabismus-hook, then the optic nerve, and lastly the obliqui muscles with any remaining tissues.

When the eyeball is ruptured it can no longer be removed with the same facility, and must be dissected out with scissors as if it were a collapsed cyst, care being taken that none of the sclera is left behind.

In cases of injury, the optic nerve should be divided close to the eyeball, but, when the eye contains a tumour of possible malignancy, the division of the nerve should be at the apex of the orbit. Some surgeons advise the ordinary division, and that the rest of the nerve should be sought for and dissected out afterwards; but complete removal together with the eye is perfectly easy of accomplishment. The scissors used for this purpose may be straight, or curved very slightly on the flat, and should have sufficient length of blade to reach easily to the apex of the orbit.

R. Brudenell Carter.

EYEBALL, Injuries of the.—Many of the injuries of the eyeball will be discussed under the heads of the structures respectively affected by them (*see* Cornea, Inflammation of the; Conjunctiva, Injuries of the; Eyelids, Injuries of the); but others are of a more general character. Severe blows, as from a fist, a cricket-ball, or the cork of a champagne or soda-water bottle, may rupture the sclera, which generally yields at its thinnest part immediately behind the insertion of one of the recti muscles, may cause extrusion of the lens and prolapse of the iris, or even such hæmorrhage from the choroid as to detach the retina. In some instances, the lens has been driven through a scleral rent without rupture of the conjunctiva, and such injuries have been followed by good recovery. They should be treated by rest and cooling local applications until all risk of acute inflammation is over, and only when the scleral wound has had time for union should the conjunctiva be incised, and the lens removed from its new position. When the conjunctiva participates in the injury, no hope of preserving a useful eye can, generally speaking, be entertained, and it is better to perform enucleation at once than to wait for further symptoms. The same principle will apply to cases in which a foreign body, such as a shot-pellet or a piece of iron, is lodged within the eye, but the fact of such lodgment is often very difficult to determine. The writer has met with instances in which the eyeball has been struck, or even scored, by shot-pellets, which yet have not penetrated, but which have for a time totally destroyed vision by internal hæmorrhage. With a fragment of iron, the diagnosis can always be cleared up by the use of a powerful magnet, which will act upon the fragment in such a manner as to cause pain, and which may sometimes be used to extract it. With shot-pellets, the surgeon must form the best judgment he can from a careful examination of the eye and of all the circumstances of the case, and, when doubt exists, it will be most prudent to wait the course of events. When there is certainty that a foreign body has entered the eye, even if there be a chance that it has passed out at the other side and made a lodgment in the orbit, enucleation should be performed at once.

Small incised wounds of the sclera, such as may be produced by a sharp penknife, or by a splinter of glass, are seldom dangerous unless they fall into the region of the ciliary body, but they will often require a suture. The movements of the eye tend to make them gape, and the consequent leakage of vitreous humour both prevents union and produces and maintains diminished tension. Sometimes we may have direct penetration of the vitreous chamber, sometimes a small hernia of uninjured choroid through the wound. In the latter case, in applying a suture, the hernia should be replaced by a fine spatula, and held back while the needle is passed through. A small curved needle is the best implement for the purpose, armed with a thread of fine white silk. The suture should pass through the sclera on both sides of the incision, and the suture may be cut and removed in thirty-six hours or sooner.

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EYELIDS, Diseases of the.—Hordeolum, or Sty, is an acute inflammation of the wall and circumfollicular tissue of a sebaceous gland associated with a ciliary follicle. The ciliary follicle may become secondarily involved, or inflammation of a ciliary follicle may provoke a sty. In all respects a sty is identical with a boil. It begins by localised pain, redness, and swelling at the edge of the lid. In a few hours the whole lid becomes œdematous, the bulbar conjunctiva becomes more or less red and swollen, and a muco-purulent discharge exudes from the palpebral fissure. At first sight the case may be mistaken for purulent ophthalmia. The edge of the lid is extremely tender, especially at a point corresponding with the focus of the disease. In a few hours suppuration takes place, the parts are then less tense, and matter presents around the lashes as well as on the anterior margin of the lid. If the case be left to itself the skin at the margin of the lid ulcerates, and the contents of the sty escape externally. The subjective symptoms then rapidly disappear, and the swelling gradually subsides. If the sty be opened the contents will be found to be a semi-globular mass of thick and tenacious pus. When the sty affects the inner angle of the lids, it may simulate a lacrymal abscess, and, indeed, it is sometimes at first impossible to make out whether the sac be implicated or not. Sties, like boils, are apt to recur.

The *causes* of a sty are general and local. The general causes are debility and depraved states of the system, anæmia, diabetes, uræmia, chronic constipation, functional derangement of the system, and indeed any or all of those conditions which precede or underlie the furunculous diathesis, &c. The local causes are irritation by dust, wind, impure air, insanitary conditions, badly-fitting spectacles, chronic conjunctivitis, ciliary blepharitis, catarrh of lacrymal sac or duct, &c.

The *pathology* is the same as that of furunculus or boil. The change probably begins as a circumglandular inflammation of a sebaceous gland. It never begins in the meshes of the tissues.

Treatment.—The local treatment may be abortive or curative. When the sty is first forming, it is often possible to arrest the inflammation by plucking the lashes from the ciliary follicles in the midst of the diseased area, so as to allow of the escape of the sero-pus that may have been exuded into or around the sebaceous and ciliary follicles. After epilation, either hot fomentations with water or a solution of belladonna extract should be used, or a solid stick of nitrate of silver, or a drop of pure carbolic acid, may be applied, or the follicle may be touched with the actual cautery. If the process have passed this primary stage, hot fomentations, or, if suppuration have begun, poultices may be used, and incisions should be made as soon as matter has formed. When the acute inflammation has subsided, astringent compresses, such as of lead, alum, or perchloride of mercury (gr. $\frac{1}{10}$ ad f℥j.), may be employed with benefit once or twice a day, and the edges of the lids kept softened with weak mercurial ointment—either the ammoniated mercury, or the yellow oxide, or the red oxide—each of a strength of about six to ten grains to an ounce. For the general treatment *see* Boils.

Meibomian Glands. — Though these glands are embedded in the tarsus, which is of mesoblastic origin, the cellular elements of the glands are involutions of the epidermis, and, consequently, of epiblastic descent.

Chalazion, or Tarsal Tumour, is a neoplasm connected with the Meibomian glands, and not, as commonly believed, retained secretion of these glands. It partakes of the nature of a non-infecting granuloma. It seems to begin as chronic inflammation in the cellular tissue immediately around the wall of the Meibomian follicles, and as it increases in size it causes atrophy of the tarsus, and makes its way into the acini of the glands themselves. It occurs in two chief forms, one having its seat in the substance of the lid, forming a hemispherical body which may attain considerable size; the other situated at the margin of the lid around the duct of a Meibomian gland. Marginal chalazia are usually smaller and less circumscribed than those occurring in the substance of the lids. In either form it may last for months, or even for years, without undergoing much alteration in size or shape, but its tendency is to grow until at length it encroaches upon the cellular tissue and forms a swelling under the skin, or it may lead to softening and ulceration of the mucous membrane, and finally to perforation and protrusion of the growth into the conjunctival sac. Even after this it retains its vascular connexion with the lid and continues to elongate, and may project outside the palpebral aperture like a polypus. Rarely, the skin itself may ulcerate. If the chalazion grow rapidly it encroaches upon the adjacent glands, and may set up acute inflammation and suppuration in them, or the growth itself may suppurate. Occasionally it undergoes degenerative changes, or it may, rarely, disappear spontaneously.

On everting the lids, a reddish-brown or buff-coloured patch is seen on the mucous membrane, with perhaps a slight depression at the seat of the growth. It is at this point that incisions must be made for the removal.

A chalazion consists of numerous round, pale, and slightly granular cells of variable size, and usually containing a pale spherical or sphero-ovoid nucleus; it also contains many giant-cells. The cells are embedded in a pale gelatinous and slightly fibrillar matrix; and scattered throughout the mass is a network of capillaries, along the walls of which the cells of the growth congregate and collect into groups. These collections occur especially at the places where these capillaries divide.

Diagnosis.—When situated near the margin of the lid chalazion may be confounded with chronic ciliary blepharitis; and if it inflame and suppurate, it may be mistaken for acute ciliary blepharitis or for hordeolus. A diagnosis may easily be made by observing the precise seat of the greatest swelling and redness. In ciliary blepharitis and in hordeolus this is towards the free margin of the lids, and there is always more or less crusting around the lashes; whereas in inflamed chalazion, or abscess of the Meibomian glands, the redness and swelling are towards the inner margin of the lids, and the lashes are free from crusts.

Treatment.—When small, and not causing much disturbance or inconvenience, the growth may be left alone or treated by means of simple astringent and detergent applications. If large or unsightly, it is best dealt with by everting the lids and making a crucial incision at the buff-coloured spot, and then gently evacuating all the contents, either by means of pressure or by the introduction of a small scoop or curette. It is not necessary to apply any caustic afterwards with a view of destroying the wall. Incision through the skin, or excision of the growth, is seldom, if ever, advisable. For the inflammatory thickening that remains afterwards, mild astringent compresses, with a slight irritation of stimulating ointments over the skin, or a weak solution of iodine, are useful. It is well to tell the patient beforehand that after the removal of the growth the cavity fills with blood, so that immediately after the operation the swelling may even be larger than before. The blood is, however, absorbed in a few days. Marginal chalazia are more obstinate; if they irritate the eye or disfigure the lid, they may be incised vertically, and the contents broken up and removed by means of a broad needle or a 'spud.' With a view to prevent recurrences of chalazia, all causes of irritation and congestion of the lids must, as far as practicable, be removed. Errors of refraction and disorders of accommodation should be corrected by suitable lenses placed in properly fitting frames; using the eyes under unfavourable conditions of air, or light, or position should be discontinued, and the circulation of blood and lymph through the lids stimulated by means of douches, cold compresses, and gentle frictions with some form of weak mercurial ointment.

Abscess of the Meibomian Gland is usually a suppurating chalazion, though it may be the result of inflammation around masses of retained excretion. The pus should be evacuated by incisions on the conjunctival surface. *See also* Conjunctiva, Diseases of the.

Ciliary Follicles and Eyelashes.—The eyelashes are deeply embedded at the outer edge of the free margin of the lid. They are regularly shed and reproduced throughout life. According to the researches of Moll and Donders, each eyelash has an average period of evolution of about 100 days; and Unna has shown that little buds arise from the side of the follicles, and become themselves the sheaths of new lashes. These new lashes may take a different direction from the old ones, or may push the old ones out and assume their places. It is probable that a modification of this mode of generation may induce abnormalities of position of the lashes, or set up irritation or inflammation in the ciliary follicles.

Congestion of the Ciliary Follicles. The ciliary follicles are not infrequently irritated and more or less swollen in persons having tender and delicate skin, or who have to use their eyes excessively or under unfavourable conditions, such as in crowded, ill-ventilated, ill-lighted, smoky or dusty rooms and workshops; or who wear badly fitting spectacles, or use improper lenses. Congestion of the edges of the lids, accompanied by an accumulation of fine bran-like crusts about the lashes, is a common concomitant of uncorrected errors of refraction, and especially of hypermetropia, with or without astigmatism. With this there is generally also some follicular conjunctivitis. While this form of congestion of the edges of the lids may primarily be dependent upon weak sight, it becomes in its turn a cause of asthenopia, and may by slight causes be excited into actual inflammation of the follicles.

Treatment.—The predisposing and exciting causes enumerated above must be diligently investigated and, as far as practicable, removed. Locally, mild alkaline or astringent lotions and a simple ointment, or some form of weak mercurial ointment, may be applied. In slight cases, boracic acid ointment is an elegant and agreeable application.

Blepharitis Ciliaris, or inflammation of the ciliary follicles, is perhaps the commonest of diseases of the lids. It has been called by various names, some of which have reference to the appearances which the diseased lids present, others to various views of the nature of the pathology. The following are some of the commoner synonyms:—Belpharitis marginalis, lippitudo arida, psorophthalmia, tinea tarsi, ophthalmia tarsi, blear-eye.

The disease is an inflammation of the cellular tissue in and around the walls of the ciliary follicles. It is characterised by redness and swelling, together with the formation of papules, pustules, or ulcers at the margins of the lids. It may affect only one or two follicles, or it may involve all. It presents itself in one of three modes—either acute, sub-acute, or chronic; and there are three chief varieties—the simple inflammatory, the hypertrophic, and the suppurative or ulcerative.

(1). In *simple blepharitis* there are redness and swelling of the edges of the lids, involving the area occupied by the ciliary follicles. Only a few of the follicles may be affected, but more commonly the inflammation extends along the whole margin. Thin crusts form, under which are superficial excoriations, discharging ichorous fluid or actual pus. If neglected, simple blepharitis may develop into the more severe forms.

(2). The *hypertrophic* variety is characterised by great thickening of the edges of the lids. The margins of the lids are elevated, rounded, along the whole length of the tarsal border and for about from an eighth to a sixth of an inch of its breadth, embracing, in fact, the whole follicular area. The lashes gradually fall out or change their position. Even in this form there is some ulceration of the skin around the lashes, together with the formation of thin crusts.

As the fluid and cellular elements of the inflammation become absorbed cicatrization ensues, with displacement, inwards or outwards, of the edges of the lids and probable inversion of the lashes.

(3). The *ulcerative form* occurs especially in strumous persons. The inflammation is more intense, and of a lower type, and there is early suppuration and ulceration. Pustules and purulent crusts form at or round the base of the lashes.

Sequelæ.—The follicles may be so much damaged that they grow only ill-formed lashes, which are generally turned towards the eyeball (trichiasis); or they may be completely destroyed, so that they cease to grow lashes at all (madarosis); cicatrization may lead to eversion of the edges of the lids, and consequent displacement of the lacrymal puncta and overflowing of the tears; or it may lead to inversion of the edges of the lids and eyelashes (entropion and trichiasis); or it may induce contraction of the palpebral fissure (blepharophimosis). In some cases persistent thickening of the edges of the lid remains (tylosis).

The *Causes* are general or remote, and local: *general or remote*, struma, uterine diseases, sexual disturbances, constipation, &c. Some races seem to be especially prone to it, as the Jews. Among the *local* causes are occupations which necessitate exposure to impure atmosphere, whether the impurity be mechanical, chemical, or organic. The presence of morbid secretions of the adjoining glands may set up irritative septic changes in the ciliary follicles. Retention of fluids in the lacrymal sac and their consequent decomposition, chronic conjunctivitis, or the presence of vegetable fungi in or around the lashes, may be the exciting local causes. The disease may be, however, due primarily to errors of refraction, or to badly-fitting spectacles and *pince-nez.*

Pathology. — The disease begins by changes in the circumfollicular tissue, the follicle itself being implicated secondarily. The cells of the root-sheath and of the hair-root undergo retrogressive changes; and at length the structures at the base of the follicle may be destroyed.

Treatment.—Local: removing the hairs from the diseased follicles and the clipping off the rest facilitates the application of remedies, which should consist, in the first instance, of alkaline lotions to soften and detach the crusts and lessen the discharge, and then mild astringent compresses, such as perchloride of mercury (gr. $\frac{1}{4}$ ad f℥j.), lead, alum, zinc, &c. The skin should be protected by ointment, such as zinc, lead, or boracic acid ointment, or diluted ammoniated mercury (gr. v.–x. ad ℥j.), or Hebra's ointment. In the later stages, when all the inflammation has subsided, stimulating ointments, such as sulphur, tar, and oil of cade should be used.

The complications and concomitants of blepharitis marginalis must be treated according to the indications enumerated elsewhere.

In the hypertrophic form, repeated puncturings with a broad needle, and the subsequent application of the mitigated stick or of a strong solution of nitrate of silver (gr. xv.–xxx. ad f℥j.), may be of service. Where there is much ulceration, after the crusts have been removed, and the loose lashes pulled out and the others cut short, the exposed ulcers should be carefully painted with a solution of nitrate of silver, or a solution of perchloride of mercury (gr. $\frac{1}{2}$ ad f℥j.). The lids should subsequently be bathed frequently with lead or boracic acid lotion, and ointment kept applied in the intervals.

Appropriate internal treatment should be used in addition to local remedies: cod-liver oil, arsenic, iron, quinine. The sulphides, the sulphites, and hyposulphites are among the most useful medicaments.

Trichiasis and Distichiasis.—Though each of these may occur independently of the other, they are commonly associated. By the term trichiasis is meant an irregular and disorderly growth of the eyelashes, some or all of which turn towards the eyeball; while by the term distichiasis (*δίστιχος*, with two rows), is meant a growth of an appreciable row of lashes within the normal row. The second row may be short and consist of only a few hairs, or it may be longer and extend along the greater portion of the edge of the lid. The lashes in trichiasis may present normal appearances, but frequently they are fine, almost colourless, and twisted, so that they may easily escape hasty observation.

These disorders are usually associated with incurvation of the lid or actual entropion, and in turn the irritation set up by the lashes increases the entropion by inducing spasm of the orbicularis.

Trichiasis and distichiasis sooner or later produce inflammation and ulceration of the cornea, which, if allowed to go on unchecked, may ultimately destroy the eye. The ulceration is often extremely obstinate, and indisposed to heal even after the primary cause of the irritation is removed.

Treatment. — Epilation always gives present ease, but it is at best a temporising expedient. More radical procedures are needed in order to secure permanent relief. The bulbs must be destroyed or excised, or transplanted. Electrolysis is the most effectual means of destroying the bulbs if only a few be affected. A needle attached to the negative pole of a battery is passed down the follicle, while the positive pole is placed on the temple. An eschar is produced and the bulb is destroyed. Excision is more suitable when more of the follicles are implicated, and when there is neither incurvation nor entropion. The edges of the lids being fixed in a clamp to prevent bleeding, an incision about one-sixth of an inch deep is made along the edge of the lids, just within the lashes to be removed. A similar incision is made in the skin outside the lashes. The intervening lashes and bulbs are then carefully and completely removed. Should any bulb escape, as indicated by the black point at the bottom of the wound, it must be separately removed.

Transplantation is generally reserved for those cases in which the trichiasis involves the whole length of the lid. The operation most commonly practised is that originally proposed by Jaesche, or some modification of it. The lid is split along the margin between the eyelashes and the Meibomian follicles. The intra-marginal incision should be about one-sixth of an inch deep, so as to extend beyond the follicles. When the row of lashes has by this means been freed, an elliptical piece of skin is removed from the surface of the lid. Sutures are then inserted, and the row of lashes drawn away from the margin of the lid. *See* also Entropion.

Emphysema is due to fracture of the nasal, frontal, or ethmoidal bones, with laceration of their mucous membranes. It is usually due to direct violence, though it may result from violent sneezing or blowing of the nose. After the laceration, the lids may suddenly puff up when a strong expiratory effort is made; the swelling having the peculiar crepitation so characteristic of the presence of air. As regards treatment, moderate pressure is all that is needed, and avoidance of anything like violent expiratory efforts, such as occur in blowing the nose, sneezing, or playing on a wind instrument.

Emphysema of the lids and orbit is very serious if associated with fracture of the skull.

Abscess of the Lids declares itself by the cardinal signs of redness, heat, swelling, pain. The redness in severe cases is often extremely dusky. The bulbar conjunctiva may be injected and much swollen (chemosis). In the early stages, in addition to a general œdema of the lid there is a localised swelling, which is at first hard and tense, and often feels like a solid growth. The lids cannot be opened, and the appearances may resemble those of severe purulent ophthalmia. In a few hours softening and suppuration occur in the indurated mass. Occasionally, especially in delicate children, the distended skin may suddenly become gangrenous, and eventually is thrown off in a slough. Great cicatricial contraction may follow, with more or less eversion of the lids.

The *treatment* is that of abscess occurring in other parts of the body—hot fomentations in the early stages, poultices when pus begins to form, and evacuation of pus as soon as discovered. The incision should be made with a fine knife, and parallel with the fibres of the orbicularis muscle. A fine india-rubber drainage-tube may be inserted for a day or two, to ensure complete evacuation,

Muscular Affections. — In the lids there are two kinds of muscular fibre—the striated and the non-striated. The striated comprises the orbicularis muscle, supplied by the seventh nerve, and the elevator of the upper lid, supplied by a branch of the third nerve. The non-striated fibres, innervated by the sympathetic, are usually named after their discoverer, Müller, and are connected with the proximal borders of the two tarsi. Both sets of muscular tissue are liable to the diseases common to kindred tissues, the chief pathological states being spasm and paralysis.

Orbicularis Muscle.—*Spasm* occurs in two forms, the clonic and the tonic. (1) In the *clonic* form (nictitation), there is repeated twitching and winking of the lids. It is especially common in children who have errors of refraction. It is likewise associated with chorea, epilepsy, hysteria, or diseases dependent on central change. It may be due to overstraining of the eyes under unfavourable conditions, as bad light. In slighter forms it manifests itself as a quivering of the lid, popularly designated ‘live-blood.’

(2) *Blepharospasm*, or *tonic* contraction of the orbicularis, may be intermittent or continuous, lasting from a few seconds to some hours. It is usually intermittent at first, becoming continuous later on. In some cases it is so severe, and the spasm lasts so long, as to give rise to serious inconvenience and even to jeopardise the patient's life. A person may, for instance, be run over if seized with spasm while crossing a street.

In some cases the spasm may be arrested by pressure on one or other branches of the fifth nerve, the supra-orbital, infra-orbital, temporal, malar, or mental. These are called ‘pressure points.’

Causes.—Blepharospasm may be due to injury, disease, or irritation of the fifth or of the seventh nerve, from any cause whatever. Among the former may be reckoned foreign bodies on the cornea or in the conjunctival sac, wounds or inflammation of the cornea or conjunctiva, or ulcers of the cornea, and dental disorders. Gastro-intestinal disturbances may excite it, or it may be a symptom of a general neurosis, and is especially common as associated with facial tic. It may be due likewise to intracranial affections, especially at the base of the brain; or it may be dependent on diseases of the temporal bone, or on diseases outside the skull, as abscess of the parotid gland, &c. Or it may be due to syphilitic or rheumatic inflammation.

Treatment.—The first indication is to remove or correct the predisposing and exciting causes. The continuous current, faradic current, or blisters may be applied over the ‘pressure points.’ In obstinate cases section or excision of a portion of the nerve at the ‘pressure point’ may be tried. Division of the outer canthus of the lids is sometimes of service. Morphia, belladonna, or conium may be given internally. Eserine in doses of gr. $\frac{1}{60}$ to gr. $\frac{1}{15}$ is said to be a powerful remedy in blepharospasm. Later, tonics, as arsenic, phosphorus, strychnine, quinine, bromide or phosphide of zinc, iron, cod-liver oil, &c. *See* FACIAL SPASM.

Paralysis of the Orbicularis.—The prominent symptom is inability to close the lids (lagophthalmos). In addition there may be the other symptoms of facial paralysis—upraising of the eyebrow, and flattening of the corresponding cheek and nostril. Partly from the inaction of the lid and partly from the displacement of the edge of the lower lid, tears cannot get into the lacrymal punctum, and consequently overflow. In sleep, and in all attempts to close the lid, the cornea rolls upwards under the cover of the lid. Otherwise, the conjunctiva and cornea are constantly exposed, and are consequently liable to injuries from dust and other foreign bodies. There may be paralysis of all the other muscles supplied by the facial nerve, while the orbicular muscle escapes. On the other hand, this muscle is rarely paralysed alone. When recovery takes place in facial paralysis the orbicular muscle is one of the first to recover. Sometimes the external rectus is implicated in paralysis of the orbicularis. In such instances the lesion is probably situated in the pons varolii, or there may be hemiplegia of the opposite side. Sometimes the auditory nerve is also involved.

The *cause* may be injury or disease of, or pressure upon, any portion of the seventh nerve in its intracranial, temporal, or extracranial course, such as lesions in the pons, hæmorrhage, softening, meningitis, diseases or fracture of the temporal bone, wounds or other injury of the nerve outside the skull, or pressure of enlarged glands, nodes, &c. Syphilis and rheumatism are among the commonest predisposing causes, and a partial paralysis of the orbicular muscle occurs in true leprosy.

Treatment.—To obviate inflammation of the cornea and conjunctiva, the lids should be protected by means of a light pad smeared with boracic acid ointment. If this do not suffice, the edges of the lids should be pared and united by sutures. In addition, the treatment must be directed against the exciting and predisposing causes.

LEVATOR PALPEBRÆ SUPERIORIS.—*Spasm* of this muscle is rare. When it exists the eyelids cannot be closed either voluntarily or during sleep. It may depend upon direct injury or rheumatic irritation, or on reflex irritation of the fifth nerve, or, lastly, on central disease.

In *Paralysis of the Elevator* of the upper lid the most conspicuous symptom is drooping of the upper lid (ptosis). It may occur during intra-uterine life, at birth, or at any later period. If it exist at birth it may be the result of intra-uterine disease, or it may be the result of injury during parturition. In any case the paralysis may be partial or complete. When it is partial the lid can be raised to some extent; but when it is complete the lid hangs loose and motionless, is usually smooth, and slightly œdematous.

If the elevator muscle alone be affected, the movements of the eyeball are unimpaired; but not infrequently other branches of the third nerve are involved, so that when the lid is raised the eyeball is seen to lie towards the outer canthus, and the pupil to be semi-dilated. The movements of the globe inwards, upwards, and downwards may also be limited or entirely abolished. Ptosis is occasionally recurrent, though it may attack one side at one time and the opposite side at another.

Causes may be due to disease or injury of the third nerve, or of pressure upon it, either at the nucleus in the floor of the third ventricle, at any part along the course of the nerve at the base of the brain, in the sphenoidal fissure, or within the orbit.

Syphilis or rheumatism is a common constitutional cause.

Treatment.—As far as practicable, the constitutional and local predisposing and exciting causes should be discovered and removed. Iodide of potassium should be freely administered, and the continuous or the faradic current daily applied. If voluntary power to raise the lid do not return, the question will arise whether an operation should be performed or not. The answer will depend largely upon the presence or absence of paralysis of other muscles supplied by the third nerve. If the internal, superior, or inferior rectus be incurably paralysed, it will be inadvisable to correct the drooping of the lid, inasmuch as there will remain disturbing and distressing diplopia. If, however, the eyeball muscles be intact, an operation may be done. The simplest is the excision of an elliptical-shaped piece of skin and orbicularis muscle from the upper lid, so as to shorten the upper lid and enable the frontal muscle to draw it upwards. A subcutaneous suture may be inserted, so as to form a cicatricial band, by means of which the occipito-frontalis muscle can be made to act upon the lid.

Ectropion and Entropion will be found under their respective headings.

Ankyloblepharon is the adhesion of the edges of the upper and lower lids. This may be partial or complete, and may result from disease of the edges of the lids, or (more commonly) from injury. The inner portion of the palpebral fissure is more frequently affected than the outer.

Symblepharon, or adhesion of the lid to the eyeball, is usually the result of burns by fire or chemical solids or fluids, but it may result from diphtheritic conjunctivitis. The adhesion may involve the whole extent of both lids, or it may be confined to a much smaller area; it may affect only the sclerotic portion of the globe, leaving the cornea free, or it may occupy more or less of the cornea.

Symblepharon may be complicated with ankyloblepharon.

Treatment.—If there be only a narrow band of adhesion between the lid and the globe, it may be divided by scissors or by ligature: but if the adhesion be broader, this will not suffice, and the abnormal union must be severed by a more deliberate procedure. Transplantation in some form will be required, since reunion almost invariably takes place from mere division of the adhesion.

There are several modes of dealing with symblepharon; but the management of particular cases must to a large extent be left to the skill of the surgeon. The transplantation of a portion of rabbit's conjunctiva has been recommended, and Stellwag has suggested the employment of a portion of mucous membrane from the lips or from the vagina.

A simple and effectual way of dealing with symblepharon of the lower lid is to dissect the cicatricial band from the globe, and then, by means of a suture inserted at the apex, to turn the flap downwards towards the *cul-de-sac*, and fix it there, by passing the suture through the substance of the lid and attaching the thread to a quill or piece of rubber drainage-tube. By this means the cuticular surface of the cicatricial band is turned to the globe, while the inner surface contracts adhesions to the dissected wound in the conjunctiva. J. Tweedy.

EYELIDS, Injuries of the.—The principal injuries of the eyelids are bruises, wounds, and burns.

Bruises of the eyelids are usually unimportant though disfiguring, unless they are the result of injury to the orbit or base of the skull.

Wounds of the eyelids may be incised, lacerated, contused, punctured, or poisoned. They may not only cause deformity of the lids, but may be followed by paralysis of one or other of the muscles. Even permanent blindness may supervene on wounds of the eyelids.

Incised, *lacerated*, and *contused* wounds may involve the whole thickness of the lids, or only the skin and subcutaneous tissues. If the lid be completely divided, the edges of the wound should be brought together as early as possible by means of fine sutures or a very fine harelip pin inserted close to the margin. If this is not done, the lips of the wound will gape and become everted through the action of the orbicularis. In lacerated wounds and in incised wounds whose lips have become everted, it may be necessary to pare the edges before bringing them together. In wounds involving the lower canaliculus, an opening into the lacrymal sac should be secured before bringing the lips of the wound together. Simple incised wounds only need accurate adjustment by fine silk or horsehair sutures.

Punctured wounds of the lids may be complicated by fracture of the orbital bones or by the intrusion of foreign matter into the cellular tissue of the orbit, or even into the cranium. The prognosis should be guarded, and the treatment to some extent expectant.

Poisoned wounds may be due to bites, scratches, or inoculations with virulent matter, vaccinal, syphilitic, &c.

Burns may present every degree of severity, from slight redness of the skin to complete destruction of both lids. Burns which at first may not seem very severe may, by cicatrization, lead to complete eversion of the lids. *See* Ectropion.

Adhesion of the margins of the lids (ankyloblepharon) or adhesion of the lids to the globe (symblepharon) may follow burns.

See also Conjunctiva, Injuries of the; Cornea, Inflammation of the, and more particularly *Abscess of the Lids*, *Ankyloblepharon, and Symblepharon* under Eyelids, Diseases of the; Ectropion. J. Tweedy.

F

FACE, Fracture of Bones of the.—In extensive injuries lines of fracture may traverse the facial bones in various directions. The fractures are often compound and comminuted, or depressed. In some cases the whole framework of the face has been separated from the skull as far back as the sphenoid. Hæmorrhage, at first copious, soon ceases. The accompanying wound must be thoroughly syringed with carbolic lotion (1 in 40); adjustment must be accomplished either by the fingers or by elevators; no fragment should be removed unless completely detached and loose; drainage, when necessary, must be provided for; and the soft parts must be very accurately brought together by fine sutures. Some surgeons cover the edges of the wound with collodion. Swelling may be limited by ice or evaporating lotions.

Serum must not be allowed to collect; to evacuate it, the edges of the wound should be separated by a director gently introduced. Union occurs very rapidly, but the opportunity of removing any remaining displacement must be carefully watched for as swelling subsides. When the fracture extends into the mouth, frequent syringing with Condy's fluid should be employed. The fragment may sometimes with advantage be wired together or supported by vulcanite plates, now so skilfully made by dental surgeons.

Nasal Bones. — Fracture is due to direct, often to great, violence. The fracture is generally towards the lower edge of the bones, often transverse and depressed, or the sutures may be opened. There is frequently, also, fracture of the nasal processes of the superior maxillæ, or of the lacrymals. The nasal bones have been driven up so as to fracture the cribriform plate of the ethmoid, and lead to injury of the brain. The septum may be fractured or deflected. It may, if swelling have ensued, be difficult to reduce, or even to detect, the fracture. Ice will tend to diminish œdema and check bleeding, which may be troublesome. If examination is resisted, or the patient is nervous, an anæsthetic may be given. Necrosis may result, but it is rare. For replacement, a stiff director or a pair of closed dressing-forceps may be introduced into the nose, while the fingers are used externally. The fragments will often remain in position. If not, it is better to replace them when they slip, than to introduce plugs. In a day or two they will, as repair advances very rapidly, become fixed. It has been suggested that a hare-lip pin should be passed transversely under the fragments to support them. In cases otherwise intractable this method may be tried; a very fine drill, however, must be used, and care must be taken not to disfigure the skin. Erichsen suggests an india-rubber bag distended after introduction, as used for epistaxis; Hamilton, small pledgets of medicated wool, supplied with numbered strings, so that they may be removed in the order of introduction. Should deformity remain, Adams advises the forcible adjustment of the bones by strong smooth-bladed forceps, and the use of a screw clamp—one blade in each nostril—to support the septum. This method may be tried in even old fractures in which there is marked deformity.

Superior Maxilla.—This bone may be fractured, but only by great violence, through either its nasal or alveolar process, the antrum may be driven in or the bone may be extensively comminuted. The intermaxillary or other sutures are sometimes opened. These fractures are often compound, and attended with profuse hæmorrhage, or associated with serious injuries of the brain, and a guarded prognosis should therefore be given. Subcutaneous emphysema is often observed, which, however, soon disappears.

Treatment.—Displacement must, if possible, be at once corrected, for even slight irregularity may produce great disfigurement.

Hamilton suggests that an elevator with a cutting thread may be screwed into any depressed fragment in order to raise it. When the alveolar process is fractured, the fragments may be steadied by wiring together the adjacent teeth.

Malar Bone.—Fracture of this bone is very rare, and is produced only by great violence. It is almost invariably associated with fracture of the upper jaw or other facial bones. If, in comminuted fracture, fragments are driven into the temporal muscle, they should be removed. Displacement, if considerable (it is usually slight), should be corrected, a small incision being, if necessary, made for the passage of an elevator. Fragments once replaced will usually remain in position.

Zygoma.—Fractures of this process are very rare. They occur (*a*) from direct violence; (*b*) in association with fracture of the malar or superior maxillary bones; or (*c*) when a foreign body is thrust outwards through the mouth. Displacement is usually slight, as the surrounding bony structures steady the fragments. If depression is marked, so as to interfere with the temporal muscle, a small incision may be made, through which to introduce an elevator. The accident has been followed by stiffness of the jaw. The injury which fractures the zygoma may produce concussion of the brain. These cases therefore require close watching. Howard Marsh.

FACIAL ARTERY, The.—A branch of the external carotid, commences opposite the angle of the jaw and dips underneath the digastric and stylohyoid muscles to reach the submaxillary gland, from which it ascends over the lower jaw, two fingers' breadths in front of the angle. The artery then passes about three-quarters of an inch from the angle of the mouth up towards the nose and the inner angle of the orbit, where it ends.

Ligation.—The artery is tied, usually, as it crosses the jaw. Place the patient on the back, with a pillow below the neck; maintain the head at right angles to the neck, with the face looking towards the opposite side. Make an incision over the artery, the vessel being found, as stated above, two fingers' breadths in front of the angle, where it lies on the bone at the anterior border of the masseter muscle. The pulsations, however, are the best guide. The incision, one inch long, divides the skin, superficial fascia, platysma, infra-maxillary branch of the facial nerve, and the deep fascia. The artery is found lying on the bone, with the vein posterior to it. Pass the needle from behind forwards.

James Cantlie.

FACIAL CARBUNCLE. *See* Carbuncle.

FACIAL PALSY.—Paralysis of the muscles supplied by the facial nerve is a condition which occasionally comes under the notice of the surgeon. It may depend on a variety of causes:—first, central, including injuries or tumours of that part of the brain in which the cortical centres governing the muscles of the face are situated, or any other part through which the fibres are passing from this region to the facial nerve. Under this heading are also included the various general paralytic conditions which depend upon hæmorrhages, softening, and other causes, and belong more properly to the province of the physician. Secondly, intracranial tumours pressing upon the facial nerve in its course from the brain to the internal auditory meatus. Thirdly, injury to the nerve in its course through the temporal bone. This may arise from fracture of the skull, and may set in immediately after the accident, or at a subsequent period when the nerve is pressed upon by the new material thrown out in the course of repair of the bone. It should be borne in mind that the temporal bone may be broken without involving a genuine fracture of the skull. The more common cause of damage to the facial nerve in the bone is, however, the existence of suppuration in the middle ear and consequent invasion of the aqueductus fallopii. This condition is sometimes met with in the adult, and not very infrequently in children it is one of the causes of that very distressing condition, double facial palsy. Fourthly, damage to the nerve after it has left the stylo-mastoid foramen. This may arise simply from exposure to cold, or from accidental or intentional wounds of the face, the latter including division of the nerve, or of some part of it, in the course of the removal of tumours, the opening of abscesses, operations on the lower jaw, and other surgical procedures.

The characteristic appearance of a patient with facial paralysis need not be here described, but one sequela must be mentioned. The eyelids can, of course, be only imperfectly closed, though some slight movement of the upper lid usually, if not always, remains; the patient is thus obliged to effect the purposes of winking by turning the eye upwards, and an occasional result of the inadequate cleansing of the surface of the eyeball is the onset of conjunctivitis; and if the fifth nerve be also paralysed so that sensation is abolished, sloughing of the cornea may result. To prevent this, it is sometimes necessary or advisable to stitch the margins of the lids together, after paring them, leaving only a small aperture in the centre of the ocular slit for vision, or the lids may be fastened together by a strip of plaster or other means.

No surgical treatment can be carried out for facial palsy beyond the application of blisters over the course of the nerve, with the object of accelerating the cure of the simple 'rheumatic' or peripheral variety. It is conceivable that cases may arise in which it might be possible to stitch together the ends of the divided nerve, but it is not known that this method has ever been put in practice.

Rickman John Godlee.

FACIAL SPASM (Tic Convulsif).—Spasm of the facial muscles varies very much in degree, and no doubt also very much in its cause. The simplest forms are such as the mild and transient twitching of the orbicularis palpebrarum, which is often associated with, and probably dependent upon, rectal irritation, or some other trivial cause; or the slight jerking of the corner of the mouth, or winking of the eyelid, which is apparently little more than a habit or trick which has become second nature. The most severe form is that in which all the muscles of one side, or of the whole face, are in a perpetual state of involuntary movement; the movements, though for the most part painless, being a source of intense and wearying annoyance to the patient, and sometimes only intermitting during sleep. Between these two extremes all sorts of varieties are met with.

As to causation but little can be said. Some are apparently what may be indefinitely called hysterical affections; some appear to depend upon reflex irritation, such as the presence of carious teeth, or the existence of wax, or other mischief, in the ear, or of some disease of the eye; others, again, depend undoubtedly upon some cerebral lesion, though we are without data as to the nature of the lesion, and *a fortiori* as to its seat, but it may be assumed to be in some cases cortical and in others central. In one case, in which a post-mortem examination was made, an aneurism of the basilar artery pressing upon the facial nerve was found, but this can only be looked upon as a pathological curiosity.

In many cases the spasm is made worse by excitement, impairment of the general health, and exposure to the influence of cold winds or bright lights, while it is allayed by the opposite conditions; and in most, if not in all, the amount of twitching varies from time to time. In a severe case, affecting both sides, the eyes may be so completely closed at times that the patient is unable to see, while his head is being constantly bent forwards by the powerful contractions of the platysmata, and the angles of the mouth are being frequently drawn downwards and outwards into an ever-varying 'risus sardonicus.' Many cases are accompanied by painful affections of one or more branches of the fifth nerve.

Spasm of the facial muscles occurs in the course of other more general convulsive diseases; but these lie outside of the present subject. Closely related to 'tic convulsif' is the condition known as spasmodic torticollis, in which the spinal accessory nerve is sometimes apparently alone affected, though often a whole physiological group of muscles is affected by the movements, some being on one side of the body and some on the other—a sternomastoid, for example, acting with the opposite splenius.

The treatment of facial spasm involves a careful inquiry into the general health, and a minute search for, and, if practicable, removal of, all sources of possible reflex irritation. Galvanism appears to have been useful in a certain number of cases; and many others have in time disappeared spontaneously, not infrequently after they have resisted all known methods of treatment. The question of stretching the facial nerve has been carefully considered and several times put in practice; it appeared at one time to produce very encouraging results, for almost all the earlier cases were described as being relieved or cured. The reports were, however, published too soon. The writer, who has performed the operation on two patients, collected the statistics of all the cases published up to June, 1883, which showed that, in all but one, recurrence of the disease had taken place, although several patients had experienced a more or less prolonged relief from the troublesome symptoms. In one of his own patients the twitching returned some months after the operation, but a spontaneous cure subsequently occurred.

If the operation be decided upon, a curved incision should be made immediately below the attachment of the lobule of the ear, and another from the centre of this downwards for two inches along the edge of the sternomastoid; the parotid gland is then to be separated from the sterno-mastoid, and the latter drawn back with a hook till the posterior belly of the digastric appears. Immediately above the upper border of this muscle the nerve may be easily found in its short course between the stylo-mastoid foramen and the gland. It is then to be forcibly stretched over a hook. This method of stretching a small nerve, like the facial, is a totally different process from that of pulling a large nerve, like the sciatic, out of its bed with the finger. It involves a partial destruction of the nerve at the point stretched, and a consequent total paralysis of the nerve beyond; but it also involves the certainty of the re-establishment of the conducting power of the nerve. While the nerve is paralysed the twitching is, of course, in abeyance, but in the course of from six weeks to three months the nerve regains its function, and at a variable time after this has occurred, in most cases in which the treatment has been adopted, the spasm has gradually redeveloped itself.

The patient may have six months' respite, or even longer, and in recommending the operation this must be put before him, as well as the fact that only one case, at the present time, remains, so far as is known, cured. The only other available surgical treatment is the division of the nerve; this unquestionably relieves the patient of his trouble for ever, but substitutes the not insignificant inconvenience of permanent facial palsy, and deprives him of the possible chance of a spontaneous cure.

Rickman John Godlee.

FÆCAL ABSCESS and FÆCAL FISTULA.—A fæcal abscess is one which communicates with the interior of the intestine. The pus from such an abscess will have a fæcal odour and contain fæcal matter. Pus from an abscess may have a distinctly fæcal smell, without being in communication with the intestine, without being, in fact, according to the above definition, a fæcal abscess. Thus, suppurative collections which are in close contact with the intestine, and especially with the colon, often acquire a most offensive fæculent odour, although they have at no time communicated with the gut, and contain no fæcal matter.

Fæcal abscesses form, as a rule, in one of two ways. By one method an abscess develops outside a normal segment of the bowel. In process of time it makes its way through the wall of the bowel, pus enters the gut, and fæcal matter the suppurating cavity. Thus perinephritic and iliac abscesses, purulent collections following pelvic cellulitis, and even abscesses arising from caries of the spine, have opened up some part of the ascending or descending colon, or of the cæcum. In the other class of case the bowel is perforated as a result of ulceration, gangrene or wound, the perforation is behind the peritoneum, the intestinal contents escape into the subserous tissue, and an abscess is set up. The perforation may in some cases be upon the peritoneal aspect of the bowel, and the extravasation be limited by extensive peritoneal adhesions.

The second form of fæcal abscess is the more common of the two. It is most frequently met with in the vicinity of the cæcum, as a result of ulceration of the cæcum or appendix, or of typhlitis. Foreign bodies which have become impacted in the bowel are not infrequently discharged by means of a fæcal abscess.

The fæcal abscess is apt to spread and produce grave symptoms. It may burrow among the abdominal muscles or extend down into the pelvis. It may open through the skin, or in rarer instances into the bladder or vagina, or even into some remote part of the intestinal canal. There is, therefore, scarcely any form of abscess which requires more active treatment, and which demands more early incision. The moment the condition is diagnosed, the suppurating collection should be evacuated by the freest possible incision, and the abscess-cavity well washed out with some antiseptic solution. The condition usually passes on to that of fæcal fistula.

The term *Fæcal Fistula* is applied to a fistula that communicates with the cavity of the bowel on the one hand, and with the integumentary surface of the body on the other. The species of abnormal opening to which this term is limited, and the arbitrary distinctions established between fæcal fistula and artificial anus, are alluded to in the account of the last-named condition.

A fæcal fistula is most usually the result of a fæcal abscess which has effected an opening through the integument. It may, however, result directly from deep, penetrating wounds and gunshot injuries, which have produced an opening in the bowel at some distance from the surface of the body. In the present form of fistula, the bowel opens indirectly upon the surface. A fistulous track intervenes between the hole in the intestine and the hole in the skin. This track is usually narrow, and is very often tortuous and most irregular. It may be interrupted by a large abscess-cavity which contains both fæcal matter and pus, and discharges both at its integumentary orifice. To fistulæ which present conspicuously this mixed discharge, the term 'sterco-purulent' has been applied.

As a rule there is only one aperture in the skin, although there may be several openings into the gut. The amount of fæcal discharge varies, and is usually comparatively slight.

The serious element in the prognosis of fæcal fistula depends, not so much upon the premature discharge of the intestinal contents, as upon the fistulous track or abscess-cavity which intervenes between the involved bowel and the skin. The patient may die from exhaustion following the prolonged suppuration from the cavity of the abscess. The pus may burrow, may greatly undermine the skin, may penetrate between the layers of the abdominal muscles, may enter the pelvis, and may in this way produce an extensive area of inflammatory disease which in time exhausts the patient's strength. The pus in such cases is necessarily very foul, and erysipelas and pyæmia are not uncommon sequelæ of the condition.

The general treatment of examples of fæcal fistula consists in supporting the patient's strength, in keeping the bowels in good order so that their action is not too sluggish on the one hand nor too vigorous on the other, and in enjoining a careful diet composed of the most digestible forms of food.

As regards local treatment, the first and most important consideration is to provide a free discharge for all pus and fœtid accumulations. When an abscess-cavity exists, it should be very freely opened up, and thoroughly washed out with an antiseptic solution. It should be very frequently irrigated so that no matter be allowed to collect, and some antiseptic substance, such as iodoform or salicylic acid, should be kept constantly applied to the abscess-wall. When the escape of fæcal matter is slight, the cavity may be plugged by a material which will absorb the discharge as it escapes, while it will exercise at the same time an antiseptic effect upon the lining membrane of the cavity. For this purpose a sponge may be used, which—when dry—has been well impregnated with iodoform powder or salicylic acid. The sponge, or such other material as is used, must be very frequently withdrawn and replaced by a clean plug. Wood-wool will answer the purpose, or 'tenax,' or absorbent cotton-wool. Fistulous tracks should be opened up when possible, or dilated with a laminaria tent, or cut through with the elastic ligature when the knife seems inadmissible.

FREDERICK TREVES.

FÆCAL RETENTION. *See* INTESTINAL OBSTRUCTION.

FALLOPIAN TUBES, Diseases of the.—The Fallopian tubes are liable to stricture, to accumulation of serum (hydro-salpinx), of pus (pyosalpinx), or of blood (hæmato-salpinx), and to papillomatous disease of their lining membrane.

Stricture may arise from metritis, endometritis, or implantation of the placenta over the uterine end of the tube. It may merely cause obliteration of the uterine outlet, or it may close the tube at both extremities, and serum, pus, or blood accumulating in the tube, either of the three conditions named above may result. Gonorrhœa is said to be the commonest cause of pyosalpinx. Papilloma may either grow in an open tube, projecting into the peritoneum and setting up ascites, or it may grow in a tube already closed by inflammation. In the latter case a tumour will be formed, very difficult or impossible to diagnose from hydro- pyo- or hæmato-salpinx, or from tubal pregnancy.

A small hydro-salpinx is occasionally met with in performing ovariotomy. It may give rise to pain from spasmodic contractions of the tube, but more often gives rise to no symptoms, and is cured by reabsorption of the fluid, or by its escape either into the uterus or peritoneum. More rarely a tumour of considerable size is formed, and it may then be recognised as a sausage-like swelling in the pelvis, or as a cyst rising into the abdomen. In such a case its removal by abdominal section is justifiable.

Pyo-salpinx is a more serious condition, but is frequently cured spontaneously, by discharge of its contents through the uterus. It may, however, rupture into the peritoneum, and this is a very grave accident, and likely to cause fatal purulent peritonitis. A large pyo-salpinx may be diagnosed and removed in the same way as a hydro-salpinx; and the same rules apply to hæmato-salpinx or a papillomatous tube. It is impossible to formulate any rules for the differential diagnosis of these various pathological conditions.

Salpingotomy, the operation for their removal, differs but little from the operation of ovariotomy, and reference should be made to the full description given of that operation, for position of patient, instruments necessary, &c. *See* OVARIOTOMY.

It may be impossible to remove the distended tubes without some of their contents being spilt into the peritoneum; and, whenever this happens, the most careful and thorough sponging is necessary, for we can never be sure that the contents do not contain the causes of putrefaction. If it be a clear limpid fluid from a hydro-salpinx, careful sponging alone is necessary; but if pus or blood be spilt it will be advisable to introduce a Keith's glass tube. It is sometimes impossible to cut the uterine end of the tube through the strictured part, and a portion of the previously distended tube is left in the stump. When this happens, this portion of the tube should be thoroughly disinfected with pure tincture of iodine, and a drainage-tube should be used.

In most cases the ovaries are also diseased, or are so matted to the tubes by adhesions that their separation from them is impossible; but in other cases they are quite healthy and free, and may be left behind; the patient then continues to menstruate regularly, and suffers no inconvenience from the rupture of the follicles into the peritoneum. It is possible that in such a case the uterine stump of the tube might become patent again, and extra-uterine fœtation result; but this is very improbable, as the stump is usually very completely closed by the peritoneum growing over its raw surface. J. Knowsley Thornton.

FALSE JOINT. *See* Ununited Fracture.

FARCY. *See* Glanders.

FASCIA, PALMAR, Contraction of the. *See* Dupuytren's Contraction.

FASCIA, PLANTAR, Contraction of the. *See* Plantar Fascia, Contraction of the.

FAT-EMBOLISM.—The accumulation of fluid fat in the capillaries, consequent on extensive laceration of adipose tissue.

Causes and Pathology.—The process may be induced by any injury involving laceration of adipose tissue, its occurrence being favoured by increased tension in the region of the injury, and the presence of open vessels for the absorption of the free oil-globules. The latter enter the circulation chiefly by the blood-vessels, in part by the lymphatic system. The most favourable conditions for fat-embolism are presented in injuries to bone, the laceration of the medulla setting free large quantities of fluid fat, while the vessels are held open by their connections with the bony walls containing them. The tension consequent on blood-extravasation is another factor in its production, but not a necessary one, since the process frequently takes place in open fractures, and has been noticed in excisions and amputations. Fat-embolism is not uncommon after rupture of the liver or extensive subcutaneous injuries. It also occurs in acute osteo-myelitis, and is present in cases of diabetic coma. The fat collects in largest quantity in the pulmonary capillaries, to a lesser degree in the other organs. The fatal issue has been ascribed to the pulmonary obstruction alone, or regarded as due to the cerebral disturbance due to obstruction of the capillaries of the brain. The latter cannot be the cause of death in all cases, since in many the demonstration of extensive fat-embolism in the brain has not succeeded. Fat-embolism, in varying extent, seems to follow all fractures of bone, serious symptoms occurring in few cases only. Excretion of the fat is said to be effected by the kidneys. This does not commence at once, fat being usually not demonstrable in the urine prior to the third day, and then it does not proceed continuously, but often on two or three occasions with intervals of several days.

Symptoms.—The symptoms closely resemble those of collapse, accompanied by signs of acute pulmonary œdema. Their advent generally commences after the first twenty-four hours, usually after the patient has recovered from the primary shock of the accident. They consist in pallor, often with cyanosed lips, general muscular weakness, lowering of the bodily temperature, slow weak pulse, gradually becoming imperceptible, and respiratory embarrassment. In some cases extreme dyspnœa is observed, in others the shallow nature of the respiration is its chief peculiarity. General moist râles are to be heard throughout the chest; bloody expectoration has been noted. When the patient survives some days, oil-globules may be detected in the urine.

Diagnosis.—This may need to be made from shock, and from pulmonary embolism of the ordinary nature. In both, the period of occurrence is of importance, an interval usually intervening between the accident and signs of fatty embolism, while embolism from detachment of part of a venous thrombus is usually a much later complication than fat-embolism. The presence of oil-globules in the urine may be a useful diagnostic aid.

Prognosis.—This depends chiefly on the intensity and persistence of the symptoms; patients readily recover from the slighter degrees.

Treatment.—No specific treatment has been discovered. The ordinary treatment of shock may be supplemented by artificial respiration. G. H. Makins.

FATTY DEGENERATION is a pathological change which protoplasm may undergo, resulting in its conversion into fat.

Pathology.—It is well known from very many examples, which need not be repeated here but may be found shortly tabulated in text-books of physiology, that in the healthy body fat is continually being manufactured, as it were, by special corpuscles from the albumin and fat in the blood. Further, there is a great deal of evidence to show that fat as such is simply produced by metamorphosis of the proteid protoplasm of many corpuscles. It is this metamorphosis which reaches such a height in disease, and which then goes by the name of *fatty degeneration.*

Passing notice must here be devoted to the term *fatty infiltration.* By this expression two things are commonly understood—firstly, that corpuscles take up small globules of fat, as such, so that their protoplasm becomes crowded with fat-droplets; and, secondly, that the proper tissue-elements of a part are separated and pressed upon by ingrowth between them of adipose tissue. The latter of these conditions can be put aside at once, as foreign to the present subject; but true fatty infiltration, as contrasted with fatty degeneration, claims immediate attention. As described below, when we find an organ so fatty, by reason of its cells containing quantities of fat-particles, as justly to be considered pathologically altered, it is obviously an open question whether the protoplasm of the corpuscles is simply laden with accumulated fat brought to it as such (or in some preliminary form), or whether the proteid protoplasm is being converted into fat-droplets. Fatty infiltration, therefore, might be better termed fatty accumulation, and, accepting this view, we may examine the possible sources of the fat which a tissue may contain.

Accumulation.—(*a*) From fatty food; (*b*) from proteid food, e.g. the secretion of milk on flesh diet; (*c*) from carbohydrates.

Degeneration.— (*d*) from proteid protoplasm.

We need not here refer at further length to fatty accumulation, except to point out that this extremely simple process may be supposed to go on most readily in the liver and heart, which organs are most favourably placed for first receiving blood containing fat, as such, in a particulate state; and, further, that this clogging of the tissue-elements will tend to occur in those persons in whom oxidation-processes are sluggish and who lead an enervating life.

After these prefatory remarks, the causation of true fatty degeneration of protoplasm may now be discussed.

Etiology and Causation.—Fatty degeneration is now looked upon as a splitting of the proteid molecule into two unequal parts—one nitrogenous, and the other non-nitrogenous; thus:—

Proteid—*Nitrogenous*: terminating by further disintegration in *urea,* &c. *Non-nitrogenous*: terminating by further disintegration in fatty acids, &c.

An extreme instance of this disintegration is found in the formation of adipocere, or corpse-wax, as the Germans call it, which, according to Hoppe-Seyler, is simply a mixture of calcic palmitate and calcic stearate—the non-nitrogenous side of the protoplasmic proteid, the nitrogenous bodies having been mainly given off as compound ammonias. It is a similar change which is produced in the body as a result of disease, under circumstances to be mentioned immediately, and in which case the urea excreted by the kidneys is found experimentally to be greatly increased.

This state of things is produced most easily by poisoning with phosphorus, alcohol, arsenic, bismuth, antimony, chloroform, ether, iodoform, carbonic oxide, chromic acid, sulphuric acid, and nitric acid; by the action of febrile pyrexia, or the poison causing the same; by (experimental) continued exposure to a heated atmosphere; and as a consequence of many cachectic states, and more especially the condition produced by pernicious anæmia, and that which leads to acute atrophy of the liver. It will be seen at once that these reagents, and poisons of uncertain nature, all act powerfully on the blood-corpuscles; and it has been assumed, with some show of reason, that they owe their power of producing this lesion to their destructive influence on the red-blood corpuscles. Whether this be so or not, there can be no doubt that one factor in the disintegration of the protoplasm of the affected tissue is defective oxidation. The *rôle* played by oxidation in reducing fatty accumulation is of course obvious, and for the reason just given it is probable that the lack of the same process causes the fatty metamorphosis of originally healthy corpuscles. At the same time it is to be remembered that in many instances where fatty degeneration follows the cutting off of the blood-supply to the part the loss is not only of the oxygen-carriers, but also of all the nutritive constituents of the blood. Moreover, fatty degeneration follows on loss of function simply, and where the oxidation and circulatory processes are not directly interfered with. Such instances are fatty degeneration of muscles which move joints that have become ankylosed, and others whose motor nerve has been injured.

Pathological Anatomy.—Macroscopically, the part affected is usually enlarged, with a smooth surface, and rounded outline; it is soft, cutting easily and smoothly, may be greasy to the feel, and smears the blade of the knife. Although the specific gravity is frequently very much reduced, still the defective oxidation, &c., leads to the accumulation of so many waste products that the organ is usually heavier than normal. The colour, pale in early stages, becomes gradually more and more yellow, until in a severe case it is of a bright yellow tint, which in some instances, such as in extreme cirrhosis, becomes orange. In a very advanced state the organ may have a nauseous oily odour.

Microscopically, the corpuscles of the organ or tissue affected are found to be slightly swollen and excessively granular. The granules are of various sizes and brightly refracting. In many corpuscles small oil-globules may have already formed, and, as such degenerated corpuscles frequently rupture in the preparation of specimens, the fatty particles and globules will be found effused into the surrounding tissues. The so-called compound granular corpuscles of Gluge are nothing more than collections of such fat-particles, and occur most frequently in the nerve-centres.

Virchow attempted to lay down, as a means of microscopical diagnosis, the dictum that when the fat was visible as fine granules it was the product of fatty degeneration or metamorphosis; but that when it was present in comparatively large droplets, it was then a result of accumulation or infiltration. This distinction, although partly true, is by no means absolutely so, since in many cases of acute fatty change from poisoning, and in the acute fatty degeneration of new-born infants (probably the result of a septic poison), the result is seen as large oily droplets in the corpuscles.

The subsequent changes in such an affected tissue are simply those of disintegration. Fatty degeneration, when it is a result of cutting off of the blood-supply to a part, assumes the special form known as caseation, and as such occurs frequently in infarcts, tubercular nodules, chronic abscesses, &c. In this condition of things the protoplasm of the corpuscles affected becomes cloudy and coarsely granular; the elements then fuse together so as to form an amorphous mass, which is of a dirty pale yellow colour, usually soft and pulpy, sometimes hard and tough from the coincident development of fibrous tissue in the part affected, and sometimes calcified.

Fatty degeneration may be best detected by examination of the fresh unstained tissue (1) in water, (2) in glycerine, when the fat-droplets show strongly by being highly refracting; (3) by treating the tissue with ether, when the fat particles are dissolved out, and (4) by prolonged staining with osmic acid, 1 p.c., and subsequent immersion for twenty-four hours in equal parts of alcohol and water; weak solutions of osmic acid are often powerless.

Symptomatology.—The symptoms of fatty degeneration are of importance to the practical surgeon in two ways, especially (1) as to a patient being in a fit state to undergo an operation; and (2) a patient's ability to take an anæsthetic. The symptoms of this condition will be best grouped under the headings of the different organs specially liable to be affected, and which possess the most practical bearing on the above points.

Heart.—A fatty heart is known by a tendency to, or actual attacks of, syncope; breathlessness on exertion; and occasional attacks of dyspnœa if the health be depressed in other ways. The pulse is usually feeble in severe cases, irregular, and easily quickened; and similar evidence is afforded by physical examination, which shows a weak impulse, and at the same time the heart's sounds are distant and indistinct.

Liver.—The organ is enlarged and may cause breathlessness mechanically, constipation of a mild and irregular degree, pale stools, anorexia, and in extreme cases dyspepsia.

Kidney.—Although an important condition, the fatty degeneration of this organ presents few special symptoms beyond diminution in the excretion of urine, and occasionally fatty débris in that fluid; so that diagnosis must rest upon the signs of a similar change in other organs of the body.

Prognosis.—Unfavourable, according to the progress of the degeneration.

Treatment must clearly be directed to the two points of (1) ensuring oxidation of the tissues without overwork and exhaustion, and (2) encouraging activity of visceral function and aiding excretion of all waste-products. The first can be obtained by prolonged moderate exercise in the open air, by the sea or on moors, &c., by driving, and possibly by the compressed air bath; while the second can only be reached by administering ordinary tonics, such as iron and quinine, &c., while the action of the different organs (especially the skin) and the activity of the circulation can be encouraged by the very moderate use of Turkish or vapour baths, coupled with gentle, prolonged shampooing, graduated to the strength of the patient, so as not to cause fatigue. But the best therapeutical agency, no doubt, is out-of-door life and very moderate exercise. Victor Horsley.

FATTY TUMOURS. *See* Lipoma.

FAVUS (Tinea Favosa).—*Definition.* A contagious chronic disease of the skin caused by the growth of a fungus.

Symptoms.—Among the several skin-diseases produced by a fungus, favus is the most severe, by reason of the length of time it lasts and the great amount of permanent damage done to the skin. All regions of the body are subject to attack, but especially the scalp. Like ringworm, favus shows itself first as a small erythematous spot, which gradually spreads in the form of a ring, and in a few days becomes covered with crusts which almost immediately assume the characteristic cup-shaped form. In these early stages there is some itching, but this gradually subsides. When the disease attacks the head, the few hairs that pierce the cup will become dull in appearance and easily fall out. The cups themselves are yellow or sulphur-coloured, and, if the eruption is at all extensive or of long duration, emit a mouse-like odour which is one of the distinctive features of the disease. They are more or less firmly attached to the skin, and are difficult to remove, and leave pits. In long-standing cases the pressure of the cups causes atrophy of the skin, so that it is not uncommon for favus of the head to produce complete baldness, and the hair, once destroyed in this way, does not usually grow again. The cups vary in size from that of a pin's head to that of a split bean. On removal they will be found to be very brittle and dry, breaking up into powder, which, when placed under the microscope, is seen to be largely made up of fungus. Sometimes there is suppuration round the crusts, the dried pus mixing with the cups and altering their appearance. The disease, which usually attacks the poorer classes, is rare in England and the United States, common on the Continent, and also in Scotland, though not so common as it was formerly. It is contagious, but not so much so as ringworm, and has been known to be communicated by mice, dogs, and cats.

Diagnosis.—In the early stage favus may be mistaken for either simple erythema or ringworm; but when the crusts form the diagnosis is easy. It may also be distinguished from eczema and psoriasis by the cup-shape and yellowness of the crusts, and by the fungus found on microscopical examination. Favus of the scalp may also be erroneously taken for eczema, psoriasis, seborrhœa, contagious impetigo, pustular syphilide, or tinea tonsurans; but there are many points of difference. In eczema the surface is often moist; the redness shades off into healthy skin; the scabs are not cup-shaped or yellow; the hair often falls out, but it does not lose its lustre and permanent baldness is never produced; and, lastly, eczema is not contagious. Psoriasis, again, is distinguishable by the silvery whiteness of the scales, by the fact that the disease usually attacks other parts of the body, such as the tips of the elbows and fronts of the knees, and when the head is the part assailed the hairs are but slightly affected. In seborrhœa oleosa the crusts are more or less oily; the hairs fall out, but there is no fungus. In seborrhœa sicca the light yellow crusts do not form cups, and have not the peculiar odour of favus, and there is no fungus. Contagious impetigo has many characteristics in common with favus; but the scabs are not cup-shaped, nor do they contain fungus. Pustular syphilide, occurring early, may be diagnosed by the presence of other symptoms—sore-throat, &c.—and the mixed character of the eruption; rupia by the ulceration seen on removal of the crusts and by their conical shape. In ringworm of the scalp the different appearance of the fungus and the short, broken condition of the hairs, form a sufficiently clear distinction. In the later stages, when the hair has been destroyed, favus may be mistaken for alopecia areata and lupus erythematosus; in the former of these, however, the hair falls out, leaving smooth, bald patches, without scar; while the latter is usually seen on the face as well as on the head, and there is moreover on the margin of the scar the characteristic red appearance, and the sebaceous plugs can be extracted from the follicles.

Pathology.—When examined under the microscope the cups are seen to be composed almost entirely of fungus, called after the discoverer, Achorion Schoenleinii. The mycelium or threads are made up of ovoidal segments containing granules; the spores are large as compared with ringworm.

Treatment.—Most authorities in the countries in which favus is common lay great stress on constitutional treatment, particularly change of air to dry localities, good food, and tonics, such as iodide of iron and cod-liver oil. But, however much good may be gained from such means, a cure cannot be effected without local treatment, which must be most thoroughly carried out. The first point is to remove, by oiling, all cups and scabs, and the hairs that are diseased must be carefully epilated. Poultices should never be used, as the heat and moisture encourage the growth of the fungus. After all the crusts on the surface have been removed, the deep-seated fungus must be destroyed in one of two ways—that is to say, either by setting up inflammation by means of irritants, such as strong ointments containing carbolic acid or mercurial preparations, or by blistering; or else by applying certain drugs, not necessarily strong, that have the power of killing the fungus without inflaming or injuring the skin. Such drugs are known as parasiticides. If the former plan be adopted, care must be taken not to produce too great an inflammation, and soothing remedies must be used as soon as the fungus is destroyed. Oleate of mercury 5 or 10 per cent. is a useful remedy. As parasiticides may be mentioned: perchloride of mercury, 2 gr. to f℥j. of equal parts of sp. vini rect. and water; sulphurous acid; hyposulphite of soda, ʒj. to f℥j.; salicylic acid; boracic acid; thymol; menthol; and many others of a similar nature. When a strictly parasiticide action is required, it is important not to use fatty applications, as they tend to block the hair-follicles and so prevent the destroying drug from reaching the fungus. Ether, chloroform, and spirit are all good penetrating vehicles. The nails should be softened with liq. potassæ, scraped, and kept covered with lint soaked in one of the above-mentioned lotions. The head should be washed from time to time with a disinfecting wash, but plain soap and water should only be used with extreme caution. As favus is a very chronic disease, it must be understood that patience is required, as well as drugs, to effect a cure.

Malcolm Morris.

FEMALE CATHETER. — Several varieties of this instrument are usually sold, but the simplest form is the best, as admitting of being most effectually cleansed. This consists of a slightly curved silver tube, six or seven inches in length, and of the diameter of a No. 8 English male catheter, perforated with five or six small openings on either side near its extremity, and fitted with a fine wire stilette mounted on a movable metal plug.

When in constant use after operation, the catheter should always be thoroughly cleansed by a stream of warm water immediately after being passed, and then be placed in a vessel containing 1–20 carbolic solution until it is again required.

Method of Introduction.—This should always be effected by touch alone, without any exposure of the patient. From the right side of the bed the forefinger of the right hand is passed from behind forward between the nymphæ until the projection of the meatus urinarius—continuous with the cord-like urethra—is detected immediately in front of the entrance to the vagina beneath the pubic arch. The point of the catheter, held in the left hand, is then carried along the palmar surface of the right index finger until it enters the orifice. Unless the above plan be followed, the instrument is liable to pass into the vagina, and thus become coated with mucus or other secretions, which, if subsequently conveyed into the bladder, may readily excite catarrh of that organ. It is better, therefore, should this accident occur, to at once wash and re-carbolise the catheter before again attempting its introduction.

For *retention in the bladder*, the best form of instrument is a short, slightly-curved vulcanite tube terminating in a perforated olive-shaped bulb, to prevent its escape after introduction. A suitable length of rubber tubing, attached to its outer extremity, will convey the urine into a vessel beneath the bed containing some disinfectant solution.

W. A. Meredith.

FEMORAL ANEURISM.—A pulsating blood-sac in direct connection with the femoral artery, more common in Scarpa's triangle than in Hunter's canal, probably because the artery in the former place is more exposed to injury, and is less supported by surrounding muscles, than in the latter.

Femoral aneurisms spring either from the common femoral, from the deep femoral, or from the superficial femoral artery. Deep femoral aneurism is very much rarer than the other two. Both it and superficial femoral aneurism present very similar physical signs, and the diagnosis between the two cannot always be made. Aneurism of the profunda presents an apparent want of definition from its greater depth, while aneurism of the superficial femoral occasionally interferes with the pulse in the tibial arteries. Neither of these tests, however, can be regarded as very satisfactory, and it will be best to consider these two forms together, remembering that aneurism of the superficial femoral is so much more common than aneurism of the deep artery, that the probability is all in favour of the superficial artery being the one affected.

A regional classification of femoral aneurisms, different from the above, is made use of by some writers. In this classification, if the swelling occurs in Scarpa's triangle it is called an inguinal aneurism, and the term 'femoral aneurism' is restricted to the affection of that part of the artery which corresponds with Hunter's canal.

Aneurism of the femoral below its bifurcation usually presents the form of an ovoid, pulsating, rapidly-growing swelling, the pulsation of which may be readily controlled by pressure on the artery as it crosses the pelvic brim. While this pressure is kept up, the swelling gradually diminishes in size from partial emptying of the sac, but directly the pressure is taken off the sac fills again, with a strong expansive force. If the sac be of large size, there may be signs of venous pressure in the parts below. Thus there may be more or less œdema of the foot, or a gorged and varicose condition of the superficial veins below the knee. Aneurism of the common femoral presents somewhat similar signs, but it occurs higher up in Scarpa's triangle, and very often runs on into the external iliac artery, the swelling being felt as much above Poupart's ligament as below.

Femoral aneurism may be either sacculated, fusiform, or diffused. The first is the most common; but the long, straight course of the artery sometimes favours the formation of a fusiform aneurism. A diffused aneurism may either result from traumatic causes, or from the rapid spread of the disease and bursting of the sac in either of the other forms.

Treatment.—If the pulsation in either a sacculated or fusiform femoral aneurism can be easily controlled by pressure on the artery as it passes over the pelvic brim, an attempt should be made to cure it by compression. This may be done, if the aneurism is sufficiently low down, by two tourniquets, placed the one on the pelvic brim, the other about two inches below this point, so that the one may be relaxed while the other is tightened. In this way alternate pressure is obtained on different points, and the risk of bruising and injury to the soft parts is very much lessened. Or a combination of instrumental and digital compression may be applied. The lower of the two tourniquets spoken of above may be retained, and in place of the upper, the finger compressing the artery may be substituted. If the aneurismal swelling extend up near to Poupart's ligament, digital compression will, probably, be the only method effectually applied. This will require a staff of three assistants, so that due relief may be given as each one compressing the artery becomes tired. It has been found that ten minutes is about the average time for one person to maintain effectual compression of the femoral artery. The arrangement of the three assistants, therefore, is best made thus: one man compressing the artery; the second sitting with his hand on the aneurismal sac, to give warning directly a pulsation is felt; the third assistant resting. If the patient be very quiet, the action of the second assistant can sometimes be replaced by the use of a long, light lever, such as a bit of whalebone bougie, one end of which is fixed by a joint to some immovable substance placed close to the limb, the bougie itself resting on the aneurismal swelling, and the long arm projecting beyond it. A pulsation is then indicated by the long arm rising in the air.

Whichever method be adopted, considerable patience and endurance will be needed on the part of the patient, if a successful result is to be attained. Digital compression is usually more speedy than instrumental, because generally more perfectly applied, and twenty-four to forty-eight hours should, in most cases, decide the question whether it is possible to cure the patient in this way. It is often necessary to keep the patient very much under the influence of morphia during its application, in order to avoid the distressing and harassing pain which it often entails. Compression is generally a less successful mode of treatment with femoral aneurism than with popliteal, and if the patient prove refractory, or if the aneurism be manifestly increasing in size, it will be best to adopt operative proceedings.

The particular operation selected will depend upon the part of the artery affected. If it be the superficial femoral in Hunter's canal, ligature of the same artery near the apex of Scarpa's triangle will be advisable. If the aneurism affect the deep femoral artery, ligature of the common femoral or of the external iliac must be had recourse to. The same is true if the superficial femoral in Scarpa's triangle is the part affected, and if the common femoral be the seat of disease, ligature of the external iliac becomes compulsory. In those cases where there is a choice between ligature of the external iliac and common femoral, it is, probably, best to choose the former. The unfavourable statistics respecting ligature of the common femoral have been very much modified of late by the successful results of the Dublin surgeons in this operation. Independently, however, of these statistics, it is probable, for many reasons, that the external iliac will be a better and safer artery to tie than the common femoral; not the least of these reasons being the uncertainty which always exists as to where the common femoral divides.

Should a femoral aneurism have become diffused, an attempt may still be made to cure it, by compression or ligature, if it be seen sufficiently early. If the swelling be extensive, it may be necessary to amputate. The only operation which may then possibly save the limb is that in which the sac is boldly laid open, and the artery ligatured above and below.

H. G. Howse.

FEMORAL ARTERY.—The Common Femoral runs from the level of Poupart's ligament, in a line drawn from a spot midway between the anterior superior spinous process of the ilium and the symphysis pubis to the adductor tubercle; its average length is two inches, but it varies from half-an-inch to four inches.

The coverings are:—(1) Skin, thin and freely movable. (2) Superficial fascia, here consisting of a superficial and deep layer; the latter is called the cribriform. (3) Between the layers are the femoral glands, the crural branch of the genito-crural, and cutaneous branches of the common femoral artery with the accompanying veins. (4) Fascia lata, called at this part the iliac portion, being on the outer side of the saphenous opening. (5) The femoral sheath, embracing the femoral vessels. This sheath is formed by the transversalis and iliac fasciæ of the abdomen escaping from beneath Poupart's ligament—the former in front of, and the latter behind, the femoral vessels. There are in it three compartments, separated by two septa; the inner, for a gland, is called the crural canal; the middle is for the vein; and the outer for the artery. The sheath is but loosely applied to the artery, it being common to both artery and vein; but within the common there is the immediate sheath, characterised by its vasa vasorum.

The relations are:—In front, the coverings just mentioned. Behind, the psoas, resting on the horizontal ramus of the pubes, the anterior part of the hip-joint, and the head of the femur; when pressure is applied, the vessel slips from off the psoas, to rest internally on the origin of the pectineus. Internally, the vein. Externally, one-third of an inch from the sheath, are the branches of the anterior crural nerve lying in a groove between the iliacus and psoas.

Ligation is required for wounds, for aneurism, and varicose aneurism. Place the patient in the recumbent position, with the knee semi-flexed, the thigh slightly flexed on the abdomen, and the limb abducted; make an incision 2½ inches long over the artery in the line of the vessel, cutting downwards on the right side and upwards on the left, the incision beginning or ending just below Poupart's ligament. The structures cut through are the coverings (*see* above); the recognisable tissues are the skin, fascia with fat, fascia lata, common and immediate sheaths. When the immediate sheath is opened, the needle is passed from within outwards—i.e. from between the vein and artery. Another method of ligation is to make an incision parallel to Poupart's ligament and half an inch below it. There is then no difficulty in finding the artery and in opening the sheath directly over it.

The Superficial Femoral.—Course: From half an inch to four inches below Poupart's ligament in the guiding line given for the common, to the opening in the adductor magnus, which is, in the adult male limb, four inches, in a vertical line, above the adductor tubercle.

The coverings:—(1) The skin, movable and thin. (2) The superficial fascia, containing fat in its superficial layer; but the deep layer at the upper part is distinct, and called cribriform. The middle cutaneous nerve runs superficially to the artery. The internal saphenous vein runs upwards just internally to the line of the femoral artery. (3) The fascia lata looks thick and white above, but over the sartorius it is thinner, and allows the colour of the muscle to show through it. (4) Beneath the fascia lata, at the upper part—i.e. in Scarpa's triangle—there is a quantity of fatty tissue; beneath the fascia, below Scarpa's triangle, the sartorius muscle covers it. (5) The sartorius muscle, four inches below Poupart's ligament, touches the adductor longus, and then pursues a course downwards and inwards over the superficial femoral artery, and onwards across the knee to the tibia. The part above where it touches the adductor is Scarpa's triangle; the part below, Hunter's canal. As the artery lies in the triangle, the muscle is to the outer side; as the vessel lies in Hunter's canal, it is best exposed at the upper part by pulling the sartorius outwards, but at the lower part inwards. (6) Beneath the sartorius, and over Hunter's canal, is a special fascia—thick below, thin above—which passes from the vastus internus to the adductor longus muscle, the two boundary muscles of the canal.

Relations of the artery. A. *In Scarpa's triangle.*—This triangle is formed by the adductor longus internally; the sartorius externally; the base by Poupart's ligament; the apex four inches below the groin, where the sartorius crosses the adductor. In front, the structures given as coverings are the skin, superficial and deep fascia, and some fat. Behind, the superficial and deep femoral veins unite to form the common; a small quantity of fatty tissue separates the femoral vessels here in addition to the veins. Internally, the vein can be seen only at the upper part. Externally, the internal saphenous nerve and the nerve to the vastus internus gradually approach the artery from the anterior crural.

Ligation.—Select a point five inches below Poupart's ligament; keep this as the focal point in the operation. Place the limb as for the common; cut in the guiding line of the artery from two inches above to two inches below the focal point. Cut through skin, fat, cutaneous branches of vessel and nerves, cribriform fascia, fascia lata. Recognise the inner edge of the sartorius, clear away a small quantity of fatty areolar tissue, open the sheath, and pass the needle from within outwards to avoid the vein, especially if it is passed high on the artery.

B. *In Hunter's Canal.*—Hunter's canal extends from where the sartorius covers the superficial femoral above, to the opening in the adductor magnus. It is bounded externally by the vastus internus, internally by the adductor longus, and the roof of the canal is formed by the special aponeurosis abovementioned. In front the coverings of the artery are skin, superficial fascia, fascia lata, sartorius muscle, and the special aponeurosis; the internal saphenous nerve lies on the artery at the lower part only. Behind, the superficial femoral vein and adductor longus muscle. Internally, the adductor longus and a bit of the magnus below. Externally, the vastus internus with the internal saphenous nerve, and the nerve to the vastus internus.

Ligation of the superficial femoral artery in the middle of the thigh—that is, at the lower third of the vessel. Place the limb as for the common femoral. The surgeon stands on the outer side of whichever limb is to be operated on, cutting upwards upon the left side, downwards upon the right. The incision is to be taken one finger's breadth internal to the guiding line. With the limb held in the position as for ligature of the common femoral, make an incision four inches long, with its central point midway between the groin and the knee. Cut through skin, superficial fascia, and branches of the middle cutaneous nerve. Recognise the sartorius, and divide the fascia lata along its outer border; draw the muscle inwards and backwards by a spatula; open the special aponeurosis forming the roof of the canal on a director. The vessel is now seen with the internal saphenous nerve lying on it; pull the nerve outwards; open the sheath, and pass the needle from without inwards. James Cantlie.

FEMORAL ARTERY, Wound of the.—Incised Wound.—It rarely occurs that opportunity is afforded for surgical interference involving the main vessels, for so severe an injury usually proves rapidly fatal before assistance can be obtained. If the bleeding has been temporarily arrested by firm bandaging by the bystanders, and an immediately fatal issue thus prevented, the surgeon, before attempting to remove the bandages, should have a tourniquet, or the fingers of an assistant, placed in position over the vessel in the groin, so as instantly to exert compression should bleeding occur on removal of the bandages. It is also of great value to have a second assistant to exert compression, if necessary, below the wound.

The clot being rapidly sponged out, it may happen that the stream of blood may at once point to the wounded vessel, which can be readily secured by ligature. If, owing to the retraction of a vessel, instead of a distinctly bleeding point, blood appears to well up from the tissues, the finger should be placed over the spot, and the tissues cautiously dissected up in the longitudinal direction, and if more space is required to accomplish this, the superficial wound must be enlarged. The vessels having been securely tied with catgut, and the wound cleansed, the soft parts may be brought together. If it has been the femoral artery that is wounded, it is very probable that the vein has been at the same time damaged. In such a wound the probability of gangrene must be remembered, so that, while searching for the wounded vessel, the limb should not be unnecessarily exposed, for all the warmth possible should be retained as helping the anastomosing circulation.

When the operation is completed, the entire limb should be wrapped in cotton wool kept in position by a loose flannel bandage. The limb being slightly flexed at the knee and thigh, should be a little raised on a soft pillow.

Punctured Wound.—In a punctured wound it is impossible to say with absolute certainty that it is actually the femoral itself furnishing the blood, but if the wound be in the line of this vessel, and the bleeding of great volume, it is a fair inference to draw that the blood flows from the main artery. If the wound be in the upper half of the thigh—that is to say, in a position where the femoral artery is comparatively superficial—and situated over the course of the vessel, the surgeon may enlarge the opening with a good prospect of finding the wounded vessel without an extensive or prolonged operation. If the wound be in the lower half of the thigh, owing to the greater depth of the artery, and the possibility of its being the popliteal that is wounded, the search is rendered a far more severe and hazardous operation, and it should not be undertaken until a thorough trial of pressure has proved ineffectual. The method of applying pressure is explained under the heading of secondary hæmorrhage from this artery.

Wound of the Femoral or Popliteal, complicated with Fracture.—This is an accident which may occasionally occur in fracture of the lower end of the femur, and the popliteal has been wounded immediately behind the adductor magnus by a spiculum of bone after Macewen's operation for genu valgum. When hæmorrhage occurs after a compound fracture or osteotomy, it is of course impossible to know with certainty whether it is the main vessel or only a branch that is wounded. Pressure should be tried in the first instance, and if this fail the wound may be laid open, and the bleeding point searched for. Should this prove to be but a branch of the main vessel, it should be secured; but supposing, after laying open the wound, that it be found to be the main artery itself (the femoral or the popliteal) which is wounded, the safest course is to amputate the limb. It cannot be denied that it may occasionally happen that, by tying the wounded artery, both the life and limb of the sufferer may be saved; but looking at the terrible complication of such an accident, involving as it does an extensive incised wound, a fracture of the bone, and ligature of the main vessel, the chance of saving the limb is too remote to be weighed against the risk to life incurred, and amputation should be performed.

Secondary Hæmorrhage from the Femoral.—This must be considered, first, with reference to secondary hæmorrhage from the vessel after its ligature in continuity; secondly, when occurring from a thigh-stump.

Secondary Hæmorrhage from the Artery tied in continuity.—Four plans have been advocated for treating this serious accident, viz. (1) ligature of the external iliac; (2) pressure and bandaging; (3) an attempt to apply a ligature within the wound; (4) amputation.

Ligature of the external iliac has been mentioned merely for the purpose of condemning it, since in the vast majority of cases in which this procedure has been adopted, it has either failed to arrest the hæmorrhage, or, if it has done so, it has been only at the expense of gangrene of the limb. The ligature of the iliac, therefore, is a dangerous and perfectly useless operation, and should be abolished as a method of treatment in hæmorrhage from the femoral.

Treatment by Pressure.—This undoubtedly is the method by which secondary hæmorrhage should be treated in the first instance, and, if properly carried out, will in many instances effectually and permanently control the bleeding. Few studies in surgery are more instructive and interesting than that of the literature of secondary hæmorrhage from the femoral artery; for, not only is it shown that many cases have been successfully treated by pressure from the first, but that both life and limb have been saved by this means after the surgeon has failed to find the artery in the wound, or where the iliac has been tied in vain.

Method of applying Pressure.—Great care and attention to detail are necessary for its successful application, for, on the one hand, if an undue amount of force be used, gangrene results; on the other, if it be but timidly applied the treatment will prove ineffectual. It should further be remembered how frequently, in secondary hæmorrhage from an artery tied in its continuity, it is the lower end of the vessel that furnishes the blood, so that it becomes a matter of great importance to exert well-directed pressure not only above but below the wound. The main vessel being effectually compressed in the groin, the limb, gently raised, is carefully bandaged from the foot upwards to within a short distance of the wound, which is not covered. The tips of the toes should be left exposed, in order to allow the surgeon to judge of the condition of the circulation. The bandage is then continued as a spica above the wound and over the groin. Rollers the thickness of the index finger, prepared as previously described, are then placed along the course of the main vessel, the one above, the other below the wound. These rollers are placed outside the flannel bandage enveloping the limb, and are kept in position each by a few turns of a separate bandage. A conical pad of eighty pieces of lint, the smallest the size of a shilling, the largest two inches in diameter, is laid directly over the orifice from which the blood has been issuing. This pad being liable to slip, must be kept in position by a couple of cross-pieces of narrow strapping, after which compression can be exerted on it by a few turns from a roller. *See* ARTERIES, Wounds of.

On the opposite or outer side of the thigh may be placed a well-padded broad splint, over which the three bandages compressing the two rollers and the conical pad are carried. The value of the splint consists in firm pressure and counter-pressure being obtained without the thigh being circularly compressed. The compressing pads, being independent of each other, allow of the pressure being diminished or increased as any one of them may require. The whole limb should be slightly raised on a pillow, and partially bent at the knee and thigh.

Search for the Bleeding Vessel in situ *and Amputation.*—If hæmorrhage recur, and cannot be controlled by tightening one or other of the pads, the whole apparatus should be removed, and once more carefully applied. Should this fail, or the limb be in such a condition as to forbid the further trial of pressure, an attempt may be made to tie the artery in the wound, and in a good light with a little dissection upwards and downwards this may sometimes be successfully accomplished; but it has occurred to surgeons of experience, that, owing to the disorganised state of the part, they have failed to pick up the vessel. If this be the case, desperate as the measure may seem, there remains no alternative other than that of amputating the limb through or just above the seat of ligature.

The greatest care should be observed in such an amputation that as little blood as possible be lost, and a Davy's lever, or other effectual means of preventing hæmorrhage during the operation, must be resorted to.

Secondary Hæmorrhage from the Femoral Artery in a Stump.—The following are the three methods by which the bleeding may be treated:—(1) pressure; (2) reopening the flaps; (3) ligature of the main vessel at a higher point.

Pressure.—A tourniquet being placed on the artery in the groin, the stump is raised and, as far as practicable, the clot, if it has distended the flaps, syringed away with cold, carbolised water. The stump is then very firmly and evenly bandaged from its extremity to the groin. Two pieces of pencil, each about three inches in length, and thickly wrapped round with lint, may be laid along the course of the femoral artery. Compression is exercised upon these by two separate bandages, passing round the limb and over an outside splint on the opposite side to avoid complete circular pressure. The advantage of having the roller compress over the main artery in two portions, is that more equable pressure is maintained by tightening or relaxing one or the other as occasion may demand. The bandage used for exerting pressure on these compresses should be of domette, which has much more elasticity than cotton. Whilst the stump is being bandaged and compression applied, firm digital or instrumental pressure must be exercised in the groin. If pressure should fail to stop the bleeding, the surgeon may fall back upon one of the remaining alternatives, that is, either opening the flaps or ligaturing the main vessel higher up. Which of these proceedings is best to adopt depends upon the amount of union between the flaps.

If the bleeding should occur early in the case, before firm union is established, say within the first fifteen or twenty days, the flaps may be separated by the finger, and the vessel sought for. It is not, however, always easily found, owing to its retraction, and its being covered by granulations. With a little perseverance, however, and by using a director rather than a knife, it may be discovered and isolated from the surrounding tissue. It is well to remember how very soft the end of the vessel becomes in these cases of secondary hæmorrhage, so that the ligature of thick soft silk must be tied with much gentleness. It has occasionally happened when the surgeon has been unable to isolate the artery, that it has answered to pass a large curved needle threaded with the ligature deeply beneath the bleeding part, thus including the artery with a considerable portion of the neighbouring structures.

If the hæmorrhage has come on late in the case, the flaps being united, and the blood issuing from a sinus at the angle of the flaps, it is a less formidable procedure than breaking open so large a wound, to put a thread round the main vessel by cutting down upon it as near above the flaps as it can be conveniently found. Thus, if the amputation be through the knee-joint, the artery may be secured in Hunter's canal. If the amputation be through the middle of the thigh, the vessel should be tied in Scarpa's triangle. HARRISON CRIPPS.

FEMORAL HERNIA.—In this form of rupture the gut leaves the abdomen through the femoral ring, and descends along the crural canal. This canal is funnel-shaped, is about half an inch in length, and ends opposite the saphenous opening. Femoral herniæ are always acquired, and possess a sac. The hernia in its descent first of all takes a vertical course. At the lower end of the crural canal it bends forwards, and then tends to mount upwards over Poupart's ligament. In the upward movement it inclines also outwards in the direction of the anterior superior spine. The neck of the hernia will be at the femoral ring. The rupture, as it lies within the canal, must always be small. As soon, however, as it passes the saphenous opening and reaches the loose subcutaneous tissue, it enlarges, and may attain considerable dimensions in this latter position. The coverings of the rupture from without inwards are the skin, superficial fascia, cribriform fascia, the crural sheath, septum crurale, subserous tissue, and peritoneum. The stricture is usually at the neck, and is mainly caused by the sharp edge of Gimbernat's ligament. The femoral vein lies just to its outer side. The spermatic cord lies above the anterior border of the ring, and the epigastric artery skirts its upper and outer part. The little pubic branch of this artery passes round the ring, to ramify over Gimbernat's ligament. In 1 case in 3½ the obturator artery arises from the epigastric. Out of 101 cases where the vessel so arose, it reached its destination in 54 instances by passing along the outer side of the crural ring, a position quite free from danger in herniotomy. In 37 cases it passed backwards across the ring, and in 10 instances around its inner border. When in the last-named situation it could hardly avoid being wounded in herniotomy. A pubic vein—passing between the obturator and external iliac vein—skirts the ring, and may have the same relations to it as the artery just alluded to.

It is estimated that in 100 cases of hernia 84 will be inguinal, 10 femoral, and 5 umbilical. Femoral hernia is more common in females than in males. In males ruptures occur in the proportion of 1 femoral to 32 inguinal; but in females these two forms of hernia occur with almost equal frequency. Inguinal hernia is, excluding the umbilical, practically the only form of rupture that occurs in the female before the adult age.

Femoral herniæ are rare before the age of twenty, and very rare indeed before puberty. They seldom attain great size. When large their coverings are often very thin, and the sac of lobulated and irregular outline.

Femoral ruptures are more often strangulated than inguinal, are more often strangulated on their first descent, and are, in any case, much more difficult to reduce. Irreducible femoral enterocele is rare, but irreducible femoral epiplocele is common. Femoral ruptures are frequently inflamed, but very rarely obstructed. When strangulation has occurred, it is found that gangrene of the gut and artificial anus follow more commonly in femoral than they do in inguinal herniæ.

In applying the taxis the thigh should be flexed, adducted, and rotated inwards. If the tumour has mounted up over Poupart's ligament the pressure must be applied first in a downward direction, then backwards and upwards. In herniæ of smaller size, which have not projected far beyond the saphenous opening, the pressure is applied in a direction backwards and upwards.

In herniotomy an incision from 1½ to 2 inches in length is made along the inner side of the tumour. This incision should be parallel to the long axis of the tumour, provided that this does not involve too great a deviation from the vertical line, and should be so planned that the centre of the incision corresponds to the top of the saphenous opening. The stricture is divided by cutting inwards.

Femoral herniæ have been mistaken for psoas abscess, enlarged glands, varicose veins, and cysts. For the diagnosis *see* Groin, Affections of the. When a femoral rupture has mounted up over Poupart's ligament, it may present some of the appearances of an inguinal hernia. If, however, the finger be placed upon the spine of the pubes, the inguinal hernia will be always to the inner side of it, the femoral to the outer. The bulk of a femoral hernia is also below the line of Poupart's ligament, and the tumour can without difficulty be traced down to the saphenous opening.

Frederick Treves.

FEMUR, Fractures of the. — The numerous fractures to which the femur is liable are divided into those of (1) the upper end, (2) the shaft, (3) the lower end. Those of the upper end include fractures of the neck, fractures through the trochanter and base of the neck, and fracture detaching the great trochanter. To these must be added, in young subjects, separation of the epiphysis of the head, and that of the great trochanter.

Fracture of the neck may occur in any situation—either transversely, just below the head; in the middle; or at the base, at its junction with the shaft. The first-named injury, though it has been met with under the age of fifty, or even under twenty, after heavy falls on the trochanter, is almost confined to persons of sixty-five and upwards, and is more frequent in women than in men. In the old it occurs as the result either of a fall on the hip, or of some slight force indirectly applied, by a trip of the toe in the carpet or even a turn in bed, during which the femur is suddenly twisted on its long axis; in a few instances it has been produced by muscular action. The frequency of the accident in advanced life is due in part to atrophy of the bone, the cortical layer of which is thinned, while the plates of the cancellous tissue are absorbed; and in part to the fact that the neck often joins the shaft at a right angle instead of at an angle of 125°, as is the case earlier in life; so that not only is the trochanter more prominent and therefore more likely to be struck in falls on the hip, but the leverage with which any force acts through the shaft on the neck is much increased. Should the fracture be the result of a fall on the trochanter, impaction may occur, the lower fragment being driven into the cancellous tissue of the head; but, owing to the trivial character of the force by which the injury is generally produced, impaction is seldom present. In rare instances the head is said to be driven downwards and backwards, but as a rule it remains in the acetabulum, where, however, it is liable to more or less rotation, so that its broken surface is turned away from the lower fragment. Fracture through the middle portion of the neck may be either transverse, or oblique from above downwards and inwards, extending from the outer margin of the head to the neighbourhood of the lesser trochanter.

Fracture through the base of the neck, in a line with the anterior trochanteric ridge, though it is, like fracture close to the head, most common in elderly persons, may be met with at any age, as the result of falls on the trochanter. By the continuance of the force under which the bone gives way, the upper fragment is usually driven into the cancellous tissue of the trochanter and shaft. Should the force be only moderate, the fragments remain securely impacted, and displacement is slight; but when it is more considerable the trochanter is split in a longitudinal direction, and, perhaps, also detached from the shaft, so that the fragments are no longer mutually grasped. When this is the case the surrounding muscles draw up the limb and produce considerable shortening. This fracture was termed extra-capsular by Sir A. Cooper, in contrast to fracture higher in the neck, which he termed intra-capsular. Later writers, however, have justly pointed out that since the capsule entirely invests the neck in front, any fracture that is extra-capsular in this situation must involve, not the neck, but the shaft. Indeed, the division of fractures of the neck into the intra- and the extra-capsular groups has been by many authorities discarded, on the ground that, though there are highly important differences between fractures of the upper part and fractures of the base of the neck in respect to the prospect of union and the future condition of the limb, these are dependent, not so much on the relation of the fracture to the capsule, as on the different ages at which these injuries are chiefly met with, and the fact that in the former impaction is rare, while in the latter it is of almost constant occurrence.

Symptoms.—In a typical instance, after a fall on the hip or knee, a false step, or even a turn in bed, or some such trivial source of injury, the patient complains of sharp pain on any attempt at movement, and of a powerless condition of the limb. On examination the limb is seen to be shortened to the extent of half an inch to an inch and a half, or even more, and everted; the patient is unable to lift the heel from the bed; the trochanter is displaced upwards, and also inwards towards the middle line, so as to be less prominent than natural. There is swelling in front of the joint, due to projection of the fragments against the front of the capsule, or sometimes to extravasated blood: pressure over either the front or back of the joint is painful. Crepitus may perhaps be felt when the limb, after it has been drawn down to its proper length, is gently rotated inwards and outwards; and during these movements the trochanter is found to move through an abnormally small arc. It must be pointed out, however, that cases are often met with in which many of these symptoms are modified, or even entirely absent. Thus, owing to the presence of impaction, or more rarely because the periosteum is untorn, or more rarely still because the fracture is incomplete, the patient may be able to move the limb freely, or even walk upon it. Shortening of the limb, and displacement of the trochanter, though they are usually distinct, may be so slight, or so masked, the one by the difficulty of placing the two limbs in the same position while the measurements are taken, the other by the stoutness of the patient, that they cannot be clearly made out; in some cases eversion is very slight, and is detected only by the fact that during manipulation the surgeon experiences a difficulty in turning the foot inwards. Sometimes the foot is in its natural position, while very rarely it is markedly inverted. Crepitus is absent when, as is so commonly the case, the fracture is impacted, and also when the fragments are displaced in relation to each other; and although it may be sometimes produced by drawing the limb down and then rotating it, manipulation for the purpose of eliciting this symptom must always be employed with great caution, in view of the danger that so favourable a condition as impaction may be sacrificed, and the fracture converted into one in which the fragments may become widely displaced.

Shortening, in a previously healthy limb, is important evidence when fracture is suspected; but its absence must not always, as already indicated, be taken as any proof that fracture has not occurred. In taking measurements great care must be used. The pelvis must be placed so that the anterior superior iliac spines are on the same horizontal level, and the two limbs must be parallel to each other and in a straight line with the trunk. Above, the superior iliac spines are the most salient points, and below, either the upper edges of the patellæ or the tips of the external malleoli; but it is a useful precaution to measure to both these lower points, and to see whether the results agree. Very valuable information is afforded by the position of the great trochanter. If fracture is present, the trochanter is higher and at the same time less prominent—that is, nearer to the middle line than that of the opposite side.

The position of the trochanter may be ascertained either by Nélaton's or Bryant's line. Nélaton's line is drawn from the anterior superior iliac spine to the most prominent part of the tuberosity of the ischium. In the normal state, in no position of the limb does the trochanter extend above this line, while in fracture it lies above it by as much as the limb is shortened. It must, however, be borne in mind that when the neck of the femur forms a right angle with the shaft, as it may in persons in whom the bone has yielded during the atrophy of advancing life, and also in many of those who were rickety during infancy, the trochanter is placed above Nélaton's line. Moreover, the exact point of the tuber ischii to which the line should be drawn is difficult to select when the patient is stout, or when swelling is present. This test should therefore be checked by other measurements, and the suspected should always be compared with the sound side. Bryant draws a horizontal line backwards from the anterior iliac spines (that is, a line which, if continued, would form a circle round the pelvis at this level), and takes the vertical distance between it and the top of the trochanter, comparing the length of this vertical line with a similar measurement on the opposite side.

Eversion, which is generally present, and which in many instances forms so marked a symptom, is due chiefly to the weight of the limb, which as its line of gravity passes through its outer part, has a natural tendency, as is seen in sleep, to turn outwards; but it depends in part on the action of the external rotator muscles, and in part, also, on the circumstance that the neck of the bone is thinner and more brittle in its posterior aspect than it is in front, and is therefore prone to be more extensively broken down in the former than in the latter situation.

Diagnosis.—The accidents with which fractures of the neck of the femur are most likely to be confounded are—fracture of the upper border of the acetabulum and displacement of the femur upwards; fracture of the bottom of the acetabulum, the head of the bone being driven through its floor; dislocation of the femur upwards and backwards, or on the pubes; severe bruising about the hip. In elderly persons, however, in whom fractures of the upper end of the femur are so common, fractures of the acetabulum, whether involving its rim or its floor, are almost unknown; and though in early or adult life they are occasionally met with as the result of great violence, they are still of very rare occurrence. In fracture of the edge of the acetabulum, if a large piece is detached, the limb will be shortened to the extent of an inch or much more, but can be easily drawn down when the patient is under an anæsthetic, and when traction ceases, shortening recurs; while when the femur has been drawn down it is found to present its natural outline of neck and trochanter, and to rotate naturally in the acetabulum. In fracture of the floor the trochanter is carried towards the middle line, so that its prominence is altogether lost, the bone is fixed, and any attempt at movement causes great pain. Possibly this fracture might be detected by the finger introduced into the rectum. In dislocation on the pubes, a very rare accident, the head of the bone can be felt on the pubic ramus, the normal outline of the upper end of the bone can be traced, and, moreover, the limb is generally, in this dislocation, markedly abducted.

When severe bruising has occurred, it may be difficult to exclude the existence of fracture, and a guarded opinion must be given till further examination shall have cleared up the doubt. In the article on Injuries to the Hip those cases are mentioned in which after severe contusion, without fracture, shortening, eversion, and other signs of old fracture of the neck, come on as the result of chronic inflammation and absorption. These examples have sometimes led to unjust charges of malpractice. Fracture through the great trochanter and base of the neck, so that the upper fragment is composed of the head, neck, and a portion of the trochanter, while the remainder of the trochanter forms part of the lower fragment, is an accident of which a few instances are recorded—amongst them one by Sir A. Cooper, and one very clearly described by Stanley (*Med.-Chir. Trans.*, vol. xiii.), and verified by post-mortem examination. The main interest in respect to this injury lies in the fact that it is very likely to be mistaken for dislocation. In Stanley's case the upper fragment of the trochanter had been drawn upwards and backwards towards the sciatic notch, where it was supposed to be the head of the femur. Diagnosis turns on the fixed position of the trochanter when the shaft of the femur is rotated, and the presence of crepitus. Shortening will be slight if the separation of the fragments is incomplete. When, however, the fragments are widely separated, considerable shortening is produced by the muscles acting on the femur below the fracture, and eversion is very marked.

Prognosis in these fractures must often be very grave, and should always be guarded, for while many cases recover very favourably, in many others, occurring in old persons, in spite of all the care that can be used, the injury is followed by exhaustion, congestion of the lungs, large pressure-sores, or by cystitis following enlarged prostate, and unavoidably aggravated by the use of catheters, and the patient sinks; while, even if a fatal result is averted, the limb often remains crippled, and a source of much suffering and distress.

Treatment.—This must vary somewhat with the circumstances of each case; but as it is now a well-established fact that fractures within the capsule may be repaired by bone, or by close and firm ligamentous substance; and as, in fractures of the base of the neck, bony union is of common occurrence, all cases of fracture of the upper end of the femur should, with the exceptions mentioned below, be treated with a view to obtain this result. In order to keep the fragments in apposition and at rest, the appliance most commonly in use, and on the whole the best, is the ordinary long splint carefully padded, interrupted opposite the fracture, and reaching from the armpit to the foot. Some surgeons employ Thomas's splint. With this the patient can be more easily moved and turned over, so far as this is necessary for cleanliness; but unless the bar of which it is constructed is flat, wide, well-padded, and accurately moulded to the shape of the trunk and limb, and unless the patient is placed on a soft mattress, pressure-sores are very apt to form. The double inclined plane was at one time much in favour. It is now, however, but seldom used, for it exercises no reliable influence on the length of the limb, and its tends to concentrate pressure on the sacrum. Moreover, the position of flexion which it entails is, in the long run, more irksome than that of extension in the horizontal posture.

In cases where there is impaction, the only indication is to keep the fragments at rest and prevent their separation. No extension, therefore, either at the time the fracture is put up, or subsequently, should be employed; but where impaction is absent, extension must be used to bring the fragments into apposition, and be continued to maintain them so. The weight and pulley answer well for this purpose, and enable us to discard so useless and objectionable a contrivance as the perineal band. The weight should be applied by means of the strapping stirrup used in hip-disease, and it is easily combined with either the long splint or with Thomas's splint. Counter-extension may be obtained by raising the foot of the bed on bricks or wood blocks. Treatment must be continued for from six to eight weeks. In impacted fracture the splints may generally be removed at the end of six weeks, the limb being kept for another fortnight at rest between sandbags, and steadied by a weight of five or six pounds.

The exceptional cases referred to above are those occurring in very old and feeble persons, in whom confinement in one position would exhaust their strength, and lead to pressure-sores, or passive congestion of the lungs, or trouble in the urinary bladder. In these instances the limb should be placed in an easy position upon a pillow, and be steadied between sandbags, and by a weight of three to six pounds attached to the foot. As soon as bruising has subsided the patient should be raised in bed with pillows for some hours a day, so as to profit by a change of posture, and, later on, may be upon crutches, with the limb supported by a loop passing round the neck and under the sole. It is often difficult in certain cases to determine whether in non-impacted intra-capsular fracture an attempt should be made by the use of rigid apparatus to obtain bony union, for in many instances this will necessarily fail, either from the feeble nutrition of the upper fragment, or because the fragments cannot be maintained in apposition; and there may be a doubt whether the health will not give way. The decision must turn on the patient's age and general strength, and on the presence of any other injuries that may have been sustained, and which would render a constrained position more than usually difficult to bear.

Shaft.—Fractures of the shaft of the femur are much more common in the middle than at either end, and in the lower than the upper third, the proportion, stated approximately, being six in the middle, three in the lower, and two in the upper third. Fracture occurs at all ages and in both sexes, but it is most frequent in adult males, who are more exposed to the injuries by which it is produced. It is caused by violence, either direct, or indirect as in falls on the feet; or by muscular action, of which some remarkable instances have been recorded. In infants the accident has sometimes been produced during birth, and it is often met with in children under three or four. At this age it is apt to be overlooked, since it is often of the green-stick variety, transverse in direction, and attended with little or no displacement of the fragments. The writer has seen three instances in which the bone was broken, under the influence of very slight force, in attempts to straighten the limb in cases of old hip-disease. Spontaneous fracture is not rarely met with as the result of necrosis, or of new-growths which have destroyed part of the shaft.

In direction the line of fracture presents considerable variety. It is, however, generally oblique, and often runs from above downwards and forwards. In some instances the bone is split for a considerable distance in a longitudinal direction. Some cases of spiral or screw-like fracture, chiefly in the upper or the lower third, have been recorded. Occasionally there is double fracture, and as many as three fractures have been met with in different parts of the shaft. Sometimes the fragments are driven the one into the other—usually the lower enters the upper—so as to produce either impaction, or splitting of the base. Displacement is very usually present. In fractures of the superior third the upper fragment tends to be carried forwards and outwards, in part by the action of the surrounding muscles, especially of the psoas and iliacus, and in part by the lower fragment, which is drawn upwards behind it and to its inner side, so as to impart a lifting movement to it. Often, however, the upper fragment projects directly forwards, and it may even be carried inwards or backwards. The lower fragment may not only overlap, or form an angle with, the upper, but be rotated on its own long axis, either outwards, or, more rarely, inwards, so as to produce inversion of the foot.

Symptoms.—These are shortening and deformity of the thigh, which is generally curved forwards and outwards, mobility at the seat of fracture, crepitus on rotation, often to be obtained only after extension, loss of power in the limb, pain on movement. The nature of the accident is usually at once apparent; but in young children, in whom there may be very little displacement, and in adults, when the fracture is transverse, the deformity slight, and the thigh very large, muscular, and difficult to manipulate, or when the injury has led to considerable swelling, fracture may easily be overlooked.

Prognosis.—In the old and feeble, if the accident has been attended with much violence, and in cases in which the fracture is compound, and there is great injury of the soft parts or of the large blood-vessels, prognosis must be grave; but in simple fractures, carefully treated, a good result may almost always be obtained. The question of shortening has been much discussed, some surgeons holding that some degree is inevitable, others maintaining that it may be entirely avoided. The facts, however, briefly stated, are, that in many instances in which much displacement has once occurred, shortening cannot be altogether prevented; and in actual practice the amount varies, in carefully-treated cases, from half an inch to two inches and a half. When, however, the fracture is transverse, or nearly so, and there is little displacement, repair without shortening may be secured. In children, as the fracture is usually transverse, the periosteum incompletely torn, displacement slight, and muscular contraction feeble, no shortening will generally remain. The subsequent length of the limb, however, will always depend largely on the treatment that is adopted, and on the care and watchfulness with which it is carried out.

Treatment.—This subject has been much discussed from very early times, and much difference of opinion still exists respecting it; but in the present article all historical discussion must be omitted, and reference be made only to the chief methods that are now in common use.

The objects to be aimed at are: (1) adjustment and fixation of the fragments; (2) extension to maintain length; (3) support and gentle compression of the limb. The appliance most in favour in the London hospitals is a Liston's or Desault's long splint, reaching from the axilla to the foot, and combined with extension maintained either by the perineal band, by the weight and pulley, or by an india-rubber accumulator. When the perineal band is used, the splint, which should be very carefully padded, is bandaged to the outer side of the limb from the foot to the knee, the roller being passed several times round the foot and lower end of the splint, so that the two are securely connected. The perineal band is now placed in position, extension is made upon the splint and foot together, and, as soon as the limb has been brought down to its full length, the perineal band is drawn tight and securely tied; a bandage is then carried round the thigh and corresponding part of the splint, and a wide band is applied to keep the upper part of the splint in contact with the chest. Many surgeons apply a short back splint, padded, with its convex surface directed forward to the back of the thigh, so as to maintain the normal curvature of the femur forwards. Others place short splints also on the front and inner aspect of the thigh. The perineal band is, however, not in general favour; it is uncleanly, especially in female patients, and it is apt to be either so tight as to excoriate the groin, or so loose as to be useless. These objections are by no means entirely removed even when the band is made of stout india-rubber tubing. To supersede it, some have advised an axillary crutch fixed to the upper end of the long splint; but neither does this answer.

Efficient extension may be obtained by the use of the weight and pulley. A piece of strong plaster, four or five inches wide, and long enough to extend from a little above the knee to eight inches below the foot, and to return to the opposite point of the limb, is applied as a stirrup, and is secured to the limb by wide transverse pieces of strapping and a bandage; a thin piece of wood, of the same width as the strapping and about four inches long, is placed transversely in the base of the loop below the foot, so as to defend the malleoli from pressure; and through a hole in the centre of this, and a corresponding hole in the stirrup, a strong cord is passed and knotted on the proximal side; this cord runs over a pulley fixed to the bottom of the bed, and supports the weight. Care must be taken that the lower end of the splint is not entangled in the sheets, so that the action of the weight is neutralised, and a weight of from seven to twelve pounds or more will be required.

De Morgan's and Bryant's splints have each met with considerable approval. So also has Thomas's splint. Indeed the results obtained depend less on the particular splint that is used than on the care with which the treatment is carried out. In Dr. Gurdon Buck's method the thigh is surrounded by four short splints, fastened with webbing and buckles; extension is secured by the weight and pulley, and counter-extension by the perineal band fixed to the head-end of the bed. As in fracture of the neck of the femur, so in fractures of the shaft of the bone, treatment on the principle of flexing the limb on the trunk by means of the double inclined plane has been generally discarded, the extended straight position being, when long-continued, less irksome than that of flexion. The inclined plane, however, is useful in cases in which either the hip or the knee-joint is ankylosed in a fixed position; and in such instances adequate extension may be secured by using the weight and pulley, the stirrup being fixed to the thigh.

Another plan is to enclose the limb in some immovable apparatus, such as a case of starch, plaster of Paris, gum and chalk, &c. The former material has been strongly advocated by Mr. Erichsen and Mr. Gamgee. The method, however, is open to the objections:—(1) that to enclose a limb soon after a severe injury in a rigid case, which does not accommodate itself to the swelling that may follow, involves serious danger to the circulation; (2) that, once applied, the bandage allows of no examination of the fracture in order to ascertain whether the fragments are remaining in place; (3) that the bandage soon becomes loose, from shrinking of the soft parts. These dangers are not imaginary. Instances have occurred in which the limb has become gangrenous, and others in which when the bandage was removed, great deformity has been found to have occurred. This plan cannot therefore be recommended for fractures of the thigh, although plaster splints are very useful in fractures elsewhere.

Union is generally complete in about six weeks, so that at the end of this time the apparatus may be removed, and the fracture carefully examined. If the bone feels firm the limb should be left at rest between sand-bags for another fortnight, when the patient may get about upon crutches; or a plaster of Paris or other rigid bandage having been applied, he may be allowed to be on crutches at once, though for the next two months he should bear but little weight upon the limb. Before the case is finally dismissed, the surgeon should see that the knee is freely movable. If stiff it should be subjected to manipulation-movements, and, if necessary, an anæsthetic should be employed, though this is seldom required.

In children, fractured shaft of the femur is best treated by the application of four short splints to the thigh, and extension by a four or five-pound weight suspended by the stirrup, as above described. A long splint should be applied on the opposite side, to keep the child at rest on his back, while sand-bags are placed along the inner and outer side of the injured limb; or Thomas's splint, which answers very well, may be employed. To the use of plaster of Paris or other rigid splints, the same objections which were mentioned in the case of adults apply in the case of children; while the leather splint, buckling round the thigh like a wide collar, which some have recommended, is a very imperfect appliance, seeing that the thigh is short and fat, and that the femur is deeply surrounded by soft parts. Hamilton uses two long splints, one for each limb, fastened together by means of a cross-bar connecting their lower ends; with this he considers that no extension is generally required. Bryant's splint is a convenient modification of this contrivance. Union is complete in four or five weeks, and after this period has elapsed the limb should be kept for a fortnight in a plaster of Paris or some other rigid case.

Lower End.—Fractures of the lower end of the femur, which are situated entirely above the condyles, may be either transverse—but this is rare—or oblique in any direction, their most usual course being from above downwards, and from behind forwards. Another group includes those which involve the knee-joint. In some of these cases, as the result of kicks, blows, or other direct violence, a part or the whole of the condyles is detached from the shaft; while in others, produced generally by falls on the knee, the two condyles are not only separated from the shaft, but are also split asunder by the wedge-like action of the patella. This injury closely resembles the T fracture of the lower end of the humerus, where in falls on the elbow the olecranon acts so as to split the lesser fragment into two lateral pieces. In transverse fracture the shaft is sometimes driven into the cancellous tissue of the lower fragment. Diagnosis is usually readily made. When the joint is involved there is generally distension of the synovial cavity by effused serum and blood. The condyles, one or both, are found to be movable on the shaft, and an increase in the width of the lower end of the bone, or some irregularity in its outline, is detected. Crepitus may be felt by moving the condyles in an antero-posterior direction, or by rotation of the leg.

Prognosis.—As fractures of the lower end of the shaft are generally oblique, and attended with considerable displacement, it is difficult to avoid shortening. This, even after very careful treatment, will sometimes amount to an inch and a half or even two inches. When fracture passes through the condyles and involves the joint, the normal outline of the articular surfaces is lost. Sometimes, after the acute inflammation of the joint which follows the injury, fibrous or even bony anklyosis occurs. Any of these conditions, coupled with shortening, greatly impairs the function of the limb, and produces permanent lameness.

Treatment.—Fractures above the condyles are, like fractures higher in the shaft, best treated either by the long splint, with the addition of short splints if these seem to be required, and extension by means of a weight of from ten to twenty pounds; or one of the other methods already mentioned may be employed. In fractures involving the joint, the fragments must be as far as possible restored to place by manipulation, the patient if necessary being placed under an anæsthetic. When reduction has been effected, the limb should be placed on a back splint and swung by the method described under Leg, Fractures of the. The back splint, however, must extend for some distance up the thigh. Or the limb may be placed in a raised position in Gant's apparatus for excision of the knee, which consists of a simple straight back splint, and a long outside splint extending from the trochanter to the foot and interrupted at the knee; or the long splint and extension may be used. In some examples the fragments remain in position best when the limb is placed on the double inclined plane. When the joint is much injured, an icebag should be applied, and care must be taken to avoid all constriction of the limb above. Should the joint be tensely distended, it may sometimes be advisable to aspirate it; but as this is a proceeding which may be followed by serious results, the cases in which it should be performed must be very carefully selected, and every care, during the operation, must be used. Passive movement should be commenced at the end of five weeks, and be carefully followed up; but no undue force must be used. The operator will find it most convenient to use his own knee, placed behind the patient's joint as a fulcrum, and then to flex the leg, slightly at first, and by degrees to carry it through its full normal range.

Should the patella be adherent to the condyles, forcible flexion would lead to rupture of the ligamentum patellæ.

Separation of Lower Epiphysis.—An injury closely resembling fracture through the condyles consists in separation of the lower epiphysis from the shaft. This accident is very rare, and can occur only in those who are under the age of twenty, for after this period consolidation of the bone is complete. Very few, if any, cases, however, have been recorded in subjects above sixteen. The injury may result from the passage of a wheel or other direct violence; but it is generally produced indirectly, by a wrench or twist; in one case it was caused by a rope in which the limb was entangled. Although the epiphysial line is above the level of the synovial membrane, the articulation is often involved through laceration of the intervening soft parts. Sometimes a vertical fracture between the condyles—of course entering the joint—is present. The amount of displacement varies. Sometimes it is so slight that the injury may easily escape notice, or be mistaken for a mere traumatic synovitis. In other instances the epiphysis is thrown completely in front of the lower end of the shaft, which projects backwards into the popliteal space. The other symptoms are pain, swelling of the joint, and crepitus; the latter, however, is often very indistinct. In some cases the popliteal vessels have been compressed by the backward projection of the bone, and the limb has become gangrenous, so that amputation has been necessary. When displacement is complete, it may be impossible to effect reduction, and amputation may be called for, though it ought not to be resorted to until it is clearly proved that the limb is useless. If displacement can be corrected a satisfactory recovery will generally take place, though, in some cases, the joint becomes stiff, or shortening results from arrested growth. The treatment, after reduction, is the same as that for fracture close to the condyles. When consolidation has taken place, should stiffness remain, an attempt may be cautiously made to restore movement, when the patient is under chloroform, by manipulation; but no violence must be used. Howard Marsh.

FERGUSSON'S EXTENDING ARM-SPLINT consists of a rectangular iron splint for the inner side of the arm and forearm. The upper end of the arm portion is provided with a crutch for the axilla, against which extension may be made by means of a screw apparatus which elevates the crutch. The forearm and lower part of the arm are first fixed to the splint, and then the crutch is raised into the axilla, care being, of course, taken not to make too much pressure there. Bilton Pollard.

FIBROUS TUMOURS. — The non-malignant tumours which are classed under this heading, and the basis of whose structure is fibrous tissue, include—first, the softer fibro-cellular tumours, which may be either (*a*) diffused growths of the subcutaneous tissue, as molluscum fibrosum and the more pendulous forms of elephantiasis arabum; or (*b*) single encapsuled tumours, usually pedunculated, and found most commonly connected with the labia and external generative organs, but also seen in the neck and sometimes deeply placed between muscles. Secondly, the firm, hard fibromata, in whose composition other tissues have a share, which occur either as single or multiple growths, and are either superficial, as in the 'painful subcutaneous tumours,' or deeper, as in 'uterine fibroids,' or firmly connected with periosteum and bone, notably of both upper and lower jaws and adjacent bones.

Cause.—Beyond the circumstance that, in the case of fibrous tumours of the uterus, evidence of inheritance may be often made out, no explanation for the occurrence of fibrous tumours can be given. Elephantiasis being an overgrowth, and due to obstruction in the lymphatic circulation, cannot be adduced as a cause of fibrous tumours in general.

Pathology.—In the more pure types of fibrous and fibro-cellular tumours, interlacing bands of white fibrous tissue with scattered cells, oat-shaped or rounded, are seen under the microscope; but in the majority of fibromata these elements of fibrous tissue are mingled with oil-globules or fibres of unstriped muscular and other tissues. On section, fibrous tumours cut firmly, are white and glistening, and rather friable.

The tendency of fibrous tumours is steadily to increase, and they may reach to many pounds in weight. Some are painful, but this symptom appears to depend upon nerve-tissue entering into their composition, or upon their being subjected to compression by neighbouring fibrous structures, in which case it may even be doubted if the pain is not due to the tension upon those parts by the enlarging tumour.

These tumours seem peculiarly liable to degenerate, the production of cysts, or the occurrence of gelatiniform and calcareous deposits, being the most frequent changes; moreover, uterine fibromata are wont to atrophy when the menopause occurs.

In large pendulous tumours the skin often inflames and ulcerates, whilst the tumour itself may mortify and slough away.

Diagnosis. — Fibromata and cellulo-fibromata, when single, are usually firm to the touch, and may be even very hard; are ovoid in shape, and very imperfectly lobed, and they have a distinct tendency to be pedunculated. Even when soft, they have not that sense of fluidity which is so deceptive in lipomata, and for this reason they are unlikely to be mistaken for chronic abscess; but the hard fibromata are often supposed to be either cartilaginous or osseous growths. They occur usually in adult life, and hence a difficulty in diagnosing them from sarcomata presents itself.

Some forms of these growths are so characteristic as to be unmistakable—as, for instance, the outgrowths of molluscum fibrosum, and the pendulous overgrowths about the genital organs of elephantiasis, or uterine polypi.

Treatment.—Such tumours and growths as may be regarded as within the scope of direct surgical interference should be, of course, removed. Where this is impossible, either from the number of tumours or from position, various internal remedies, as arsenic and liquor potassæ, may be given, with fair prospect of success in certain instances; and, these failing, the author would advise electrolysis as offering a reasonable expectation of arresting the increase of the tumours. A. Willett.

FIBULA, Fracture of the. *See* Leg, Fractures of the.

FILARIA or DRACUNCULUS MEDINENSIS (Guinea-worm).—*Definition.* — A nematode worm of the genus Dracunculus, which attains to maturity in the human body, and produces the disease called Dracontiasis, the main feature of which is the formation of a subcutaneous tumour just before the exit of the worm.

Etiology.—The disease is due to swallowing the water containing the larvæ, and not, as formerly supposed, to the young worm penetrating the skin of the foot, &c., while bathing. The disease is endemic in Arabia, Hindostan, Upper Egypt, Nubia, Abyssinia, the Gold Coast and coast of Guinea, and a few other places.

Symptoms.—The worm gives rise to no symptoms until it is nearly mature, when it may be felt under the skin like a coil of string. When about to escape, in a mild case, a circumscribed pea-sized tumour is formed, not always at the place where the worm was first observed, with itching and a feeling of tension; the tumour ruptures, either from scratching or poulticing; a serous fluid escapes, and the white head of the worm can then be seen at the bottom of the cavity; it is usually soon protruded, and, if properly managed, the whole worm is removed in from three to ten days. In more severe cases violent inflammation may occur along the whole worm-track, and a painful abscess is then formed, with smart febrile symptoms, and the worm may die and be so softened that it breaks during extraction—a very serious accident, whether it is alive or dead, which may lead to crippling gangrene, or even death, due it is supposed, to the escape of the embryos into the tissues, and the setting up thereby of violent inflammation. In more fortunate cases the worm is discharged at a later period by the formation of a fresh tumour. The point of exit is, in over 90 per cent., in the lower extremities, usually from some part of the foot, especially the heel, but in exceptional cases has occurred from almost every part of the body. As a rule there is only one worm, but two are not uncommon, and as many as fifty have been recorded.

Pathology.—The female worm, which is alone concerned in the production of the symptoms, is one-tenth of an inch thick, and from 1 to 6 feet long, the usual size being from 25 to 30 inches, with a curved pointed tail, and a slightly convex head. It is viviparous, enclosing an enormous number of embryos which, after their escape from man, if they get into water, penetrate a minute crustacean of the genus Cyclops and undergo their full larval development; the Cyclops host is swallowed, the larvæ develop, conjugate, and then the female sets out on her migrations into the muscles, &c., while the male, it is supposed (it has never been seen) dies, and is cast out with the fæces. The female undergoes further development in the deep tissues, but it is nine or ten months from the time of her entrance into the body before she appears at the surface.

Diagnosis.—This can only be made when the worm can be felt under the skin, and is confirmed if it migrates while under observation.

Prognosis is favourable as a rule, if the worm is not broken in abstraction, or unless unusually violent inflammation occurs along the worm-track.

Treatment. — The tumour or abscess should be poulticed to facilitate its opening, and the worm should then be seized and very gently drawn out, as far as it will readily come; the end is then wound round a piece of stick, and a turn or two carefully given every day, until the whole worm is extracted, the greatest care being exercised not to rupture it. Horton recommended large doses of assafœtida, to kill the worm before the cavity was opened, and then poulticing, a plan which answers very well. When the worm is broken, and violent inflammation ensues, this must be treated on ordinary surgical principles, amputation of the limb being sometimes necessary when gangrene has occurred.

H. Radcliffe Crocker.

FILARIA SANGUINIS HOMINIS.

Historical Résumé.—In 1866, Wucherer, at Bahia, discovered, in the urine of a patient suffering from hæmato-chyluria, living microscopic nematode worms (embryo filariæ). In 1868, Salisbury described, under the title of Trichina Cystica, nematode worms he had found in the milky urine of an insane patient. In 1870, Dr. Spencer Cobbold found, in the hæmaturic urine of a young girl from Natal, besides the ova of Bilharzia, not only embryos but ova of a næmatode worm, but was doubtful of their significance. In 1870, Dr. Timothy Lewis found in the chylous urine of a patient at Calcutta microscopic nematode worms in a living state, which, on being sent to England, were classified by Dr. Parkes and Mr. Busk as belonging to the Filaridæ. In 1872, Dr. T. Lewis discovered minute nematode worms, in a state of great activity, on a slide containing a drop of blood obtained from the finger of a Hindoo. These he recognised as identical with those he had previously found in the chylous urine. The man whose blood contained the worms could not be subsequently found, so that nothing could be ascertained as to his past history, nor of the pathological conditions which may have been associated with their presence. This hæmatozoon Lewis named *Filaria Sanguinis Hominis.* He subsequently found filariæ in the blood of many patients, and in the various tissues and secretions of a number of others, all of whom were known to suffer, or to have suffered, from chyluria, or some closely-allied pathological condition. They have since been found by different observers within tolerably well-defined geographical limits.

The surmise of Dr. Cobbold, from the discovery of ova in blood sent from Australia, that the hæmatozoa were the embryos of a larger worm probably inhabiting the lymphatic system, was confirmed by the discovery of the parent worm, in 1876, by Dr. Bancroft, at Brisbane, and a few months later (1877) by Lewis in India. Parent worms have also been found, in all cases in lymphatics, by Manson in China, and by Aranjo and Los Santos in Brazil. From Bancroft being the discoverer of the parent worm, Dr. Cobbold named it *Filaria Bancrofti*, but, by general consent, the name given by Lewis (who, moreover, was the first to supply a proper diagnosis and anatomical description of the mature worm), to the hæmatozoal embryo—*Filaria Sanguinis Hominis*—has been adopted. It was further ascertained by Manson, in 1878, that the mosquito acts as an 'intermediary host,' the embryos sucked up, with the blood containing them, by the female mosquito undergoing developmental changes in its body. In 1880, Manson made a further important discovery, viz. that the embryo filariæ are not present in the circulation during the whole twenty-four hours, but that they disappear in the daytime and reappear each evening. These observations have been confirmed by Dr. Wykeham Myers, at Formosa, and by the writer, and the latter has further shown that this 'periodicity of filarial migration' is in some way connected with the moving and resting condition of the host. Lastly, Manson, from observations of his own and others, that ova sometimes escape prematurely from the female parent, has advanced a theory of the pathological changes induced by filarial infection, which unites the various maladies associated with the presence of filariæ in the human subject, and at the same time explains how the parasite may exist in the lymphatics and the embryos in the blood without any marked manifestations of its presence. The pathology of these diseases has also been elucidated by Dr. Vandyke Carter, Lewis, Sir Joseph Fayrer, and others.

The Mature Filaria Sanguinis Hominis.—The female is a fine, thread-like worm of white colour, about 3 to 3½ inches long and about $\frac{1}{100}$ of an inch wide. The body is of uniform thickness, and the cuticle smooth and devoid of transverse markings. The head is club-shaped, with simple circular mouth, destitute of papillæ. The vagina opens about $\frac{1}{25}$ of an inch from the head; it is very short, and bifurcates into two uterine horns, which run backwards nearly to the tail, and in the fecundated condition are stuffed with embryos at all stages of development. The following careful measurements by Lewis will serve for identification:—

	of an inch		mm.
Oral aperture to end of œsophagus . . .	$\frac{1}{55}$	or	·45
Diameter of oral aperture	$\frac{1}{3000}$	,,	·008
Width of neck . . .	$\frac{1}{545}$	,,	·045
,, about ¼-inch from anterior end . . .	$\frac{1}{153}$	,,	·162
Width where packed with ova and embryos . . .	$\frac{1}{100}$	,,	·25

The entire male has not yet been obtained, but a portion ½-inch in length, examined by Lewis, measured $\frac{1}{180}$ of an inch transversely; it was thinner than the female, but of firmer texture, and manifested greater tendency to coil. The intestinal canal measured $\frac{1}{633}$ of an inch across, and the spermatic tube $\frac{1}{1500}$ of an inch.

The female is viviparous, the embryos, having stretched their chorional envelopes, emerging from the vagina and manifesting active movements. Parturition appears, from observations by Manson, to be a continuous and not an intermittent process.

The *ova*, fully formed, measure about $\frac{1}{500}$ by $\frac{1}{750}$ of an inch.

The *embryos*, measuring from $\frac{1}{75}$ to $\frac{1}{90}$ by $\frac{1}{3200}$ to $\frac{1}{3500}$ of an inch, are fine thread-like worms of a uniform thickness, with rounded head and tapering tail. They are translucent and apparently structureless, but Manson describes a kind of pouting movement noticeable at the anterior extremity. The embryo is enclosed in a delicate sheath, which is often difficult to detect. When, however, the embryo has been kept for some time on a microscope slide, the body shrinks, and the sheath becomes very manifest; the animal, shortening its body, retracts itself from the superfluous envelope at one or other extremity, and again on stretching itself occupies the previously empty sac. The sac is sometimes seen folded on itself ribbon-like. The sheath is easily demonstrated by staining reagents.

The embryo, when freshly removed from the body in a drop of blood, exhibits lively eel-like movements, coiling and uncoiling its body, and lashing the blood-corpuscles by which it is surrounded. It may be kept alive for many days in a drop of blood on a slide, simply mounted with a cover-glass, especially if the edges of the preparation are prevented from dessication by a film of oil or paraffin. Under these conditions, after a time, its movements become less and less active; from being coiled its body becomes gradually extended and straightened; then only feeble movements of the extremities occur from time to time, and finally these cease. When dead, the body is nearly always more or less extended, assumes a granular appearance, and is often partly retracted from the sheath. When a slide containing a number of embryos is watched day after day, some of them disappear by a process of solution. The embryos are best searched for by a one-inch or half-inch objective, and when present, usually, if the examination is made at night, from 10 to 100 may be counted on a slide. The number circulating in the blood in most cases must be enormous. From the number counted in a cubic millimetre of blood, in a case under the care of the writer, it was computed that the patient's blood contained from 36,000,000 to 40,000,000 at the maximum at night.

Habitat of the parent and embryo filariæ.—It has been established by the observations of Bancroft, Lewis, Manson, and others, that the parent worms are located in the lymphatics, the two sexes living together. Apparently any part of the lymphatic system may be occupied, but the abdominal, iliac, scrotal, spermatic, and femoral regions seem to be involved more frequently than other regions. When the lymphatic channel is free and unobstructed, the embryos emitted from the parturient female into the lymph-stream pass with it along the thoracic duct to its termination, where they finally reach the blood. Should, however, the lymphatic channel be occluded at any point proximal to that inhabited by the parent worms, the embryos will be confined to the distal side of the obstruction, and will not reach the blood.

Filarial Periodicity.—In ordinary circumstances when the blood of a filariated patient is examined between 6 a.m. and 6 p.m., the embryo filariæ are either entirely absent, or only one or two are found in a drop of blood. At about 6 p.m. they begin to make their appearance; at 9 p.m. they are numerous, and at midnight they reach their maximum. From this hour they again diminish, so that by 3 a.m. they are less numerous, and by about 6 a.m. they have disappeared, or a few stragglers only are found. This periodicity, which was first observed by Manson, and confirmed by Dr. Wykeham Myers, is not a habit of the filariæ confined to the tropics, but has been observed by the writer in a case in this country imported from India, and in a case observed by Dr. Lloyd Jones. The knowledge of this periodicity of filarial migration is of the highest practical importance, for, unless the blood is examined *at night*, filariæ may not be discovered, even when a patient is infested with them. The full explanation of filarial periodicity has not been arrived at; but the writer has shown that, whilst it is uninfluenced by the hours at which regular meals are taken, it is in some way connected with the moving and resting (or sleeping) condition of the host. For, in a case under his observation, he was able, by turning the patient's day into night and night into day, to invert the periodicity, so that the filariæ swarmed into the blood in the daytime when the patient was at rest, and almost or entirely disappeared from the blood at night when the patient remained up and moving about. This observation has been confirmed by Dr. Manson, who has further shown that prolonged sleep probably disturbs periodicity and diminishes the number of embryos circulating at the time of maximum, and that when the usual allowance of eight hours' sleep is taken in spells of four hours at a time, at intervals of eight hours, periodicity is disturbed, and the numbers circulating at the time of maximum are sensibly diminished. The periodicity is further influenced by the febrile state. When pyrexia is present the periodicity is disturbed—not immediately, but after it has lasted for some days; in a similar manner, the regular rhythm of filarial migration is not re-established immediately on the cessation of the increased temperature of the body, but only after the fever has ceased for some days.

What becomes of embryo filariæ when they disappear from the general blood-stream, is not known. Dr. Manson suggests that they repose in the blood-vessels of the lungs, or some other blood-reservoir, during the day. Dr. Wykeham Myers has advanced the view that the embryos found in the blood each night are a separate brood, which perishes in the morning, to be replaced by a new brood the next night. This view is mainly founded on his observations as to the activity and viability of the embryos on removal from the body, at the hours when they enter and leave the general circulation. Dr. Myers asserts that, whereas those found in the blood in the evening are invariably strong, active, and long survive their removal from the body, those found in the blood in the morning are feeble, lethargic, and survive their removal from the body for a shorter time than the evening embryos. Dr. Manson has not been able to confirm Myers' observations. This theory of a diurnal brood necessitates intermittent parturition, and the issuing of a fresh swarm from the parent every twenty-four hours. In opposition to this, Manson has shown that the parturition of the adult female is a continuous and not an intermittent act. It is further thought by Cobbold, and others competent to judge, that the enormous number of embryos in the blood precludes the possibility that they could be a single brood, even assuming that several fertile females are present.

The rôle of the mosquito.—The discovery that the mosquito acts as an 'intermediary host' to the filaria sanguinis hominis—that is, that whilst in the body of the mosquito certain developmental changes take place in the embryo which fit it for its ulterior destiny—made by Manson, has been confirmed by others. It has not been clearly ascertained whether this office is confined to a single species of the culex, or whether several species are capable of performing it; but it is certain that some species of mosquito are impotent to assist the embryo, digesting them but not nurturing them. The fact that all mosquitoes are not efficient in this respect may be an explanation of the limitation of filarial infection and its results in regions quite near together. The mosquito feeds by night—the female only sucks blood—and the periodicity of filarial migration appears an adaptation of nature to allow for the removal of the embryos to complete their cycle of development. Further, there seems to be a mutual adaptation between the perforating instrument of the mosquito (the proboscis) and the shape and character of the movements of the embryos, so that when the proboscis penetrates a blood-vessel the embryos become entangled around it, or attracted to it; and thus a drop of blood from the freshly-gorged mosquito is found to contain a larger number of embryos than a drop of the blood obtained from the bitten subject. Received into the stomach of the mosquito, some of the embryos are digested even by the friendly mosquito, but others perforate the thorax of the mosquito and commence a series of changes. These have been studied with great care and detail by Manson. That certain developmental changes of the embryos take place in the body of the mosquito, has been established by Lewis, Bancroft, and Sonsino, but the later shades of development described by Manson have not yet been confirmed.

Most mosquitoes lay their eggs and die during the fifth or sixth day after feeding, so that the final stage is difficult to trace. What becomes of the filariæ after this stage can as yet be only conjectured. The mosquito lays its eggs upon the water and soon after dies, its body probably falling into the water. The embryo probably perforates the body of the dead or dying mosquito, or is liberated by its decomposition, and escapes into the water, for which medium it is admirably adapted. It is, further, in the highest degree probable that the metamorphosed and free embryo gains access to a fresh human host through the medium of drinking water, and on arriving in the alimentary canal perforates its way, by that kind of elective affinity which leads the trichina to the muscles, the liver-fluke to the bile-ducts, the strongylus-gigas to the pelvis of the kidney, &c., to some lymphatic, where it grows to adult size, is impregnated by the male, and sends forth a fresh progeny to perpetuate the species.

The geographical distribution of Filaria Sanguinis Hominis, and prevalence in infected regions.—The exact distribution of the parasite has not been absolutely determined, but judging from the diseases attributed to its influence, this is probably well-defined. It is an inhabitant of tropical and sub-tropical climates, and its limits are probably co-extensive with chyluria, so often due to it, and which Lewis states occurs, with rare exceptions, between 30° south and 30° north latitude. With regard to its prevalence, Manson has shown that at Amoy and the surrounding districts, amongst patients applying for treatment for miscellaneous diseases, and in their relatives and friends not themselves diseased, filariæ are found in the blood in about one in ten persons examined, and that, allowing for their occasional absence, one in eight persons are probably so affected. At Bahia, Drs. Paterson and Hall found filariæ in one in twelve, but from the insufficiency of the examinations, they calculate that this is an under-estimate. This, in both the above instances, is almost certainly the case, for the examinations were mostly made by day, before the nocturnal periodicity of the filaria had been discovered. Exact information on this point does not appear to have been collected in India, Australia, and other affected regions.

Both sexes are liable to be infected by the filaria sanguinis hominis, and Manson's observations tend to show that the prevalence of filarial infection increases with age.

The conditions associated with, or dependent on, filarial infection.—The above statements by Manson, Paterson, and Hall, as well as the experience of many observers in India, show not only that filariæ may be present in the blood in persons not suffering from any of the diseases attributed to the parasite, but that they may exist in the blood without any other evidence of disease. This does not militate against filarial infection being the true cause of the various morbid conditions commonly associated with their presence, for—(1), this association is too frequent to be merely the result of coincidence; and (2), an explanation can be afforded which at once accounts for the presence of filariæ in the blood without these diseases resulting, and for the production of disease in the cases in which they occur.

The diseases that have been found associated with the presence of filariæ in the blood or lymph, and have been attributed to this cause, are the following: chyluria, hæmaturia (certain forms), varicose groin-gland with lymphangitis, lymph-scrotum (nævoid elephantiasis) elephantiasis (arabum) of scrotum or legs, hydrocele and affections of the spermatic cord and testis, and 'craw-craw,' a form of skin-disease. Less certainly connected with filarial infection are—diarrhœa, cachexia, debility, deafness, and eye-disease. It is not claimed that the most typical of these are always so caused (Fayrer), but filarial infection gives an efficient explanation of the first group. With or without local disease filariated persons are liable to irregular pyrexia (elephantoid, lymphatic or filarial fever) which is often mistaken for ague. It differs from true malarial (intermittent) fever, in the irregularity of the attacks, and in the greater length of both the febrile paroxysm and interval.

Whilst many—especially Sir J. Fayrer, Lewis, Bancroft—have connected filariæ and several of the previously named diseases as cause and effect, the most complete explanation of the pathology of filarial diseases has been advanced by Dr. Manson, whose theory is as follows. The parent filariæ occupy the lymphatics, and, if the lymph-channel is free, the embryos will be carried with the lymph-stream until this commingles with the blood, whence the embryo will be carried to all parts of the body, and no disease necessarily result. If the *glands* or lymphatics traversed by the lymphatic paths are obstructed, the lymph will be dammed up, and the embryo will be confined to the distal branches of the occluded lymphatic, and not reach the blood at all.

Up to this point probably all who have had opportunities of practically studying the subject are agreed. But Manson further believes that—and this view is entirely his own—the obstruction of lymphatics and glands is induced by abortion of the pregnant female filaria. He and one or two other observers have noticed that occasionally ova escape from the female filaria. These ova, the contained embryo not having stretched the chorional envelope, equal from five to seven times the smallest diameter of the embryos, and are not capable of the propulsive movements of the latter. When the ova reach the narrow channels of the lymphatic glands, being too large to pass, they act as emboli, plug the vessels, and obstruct the lymph. 'There will then be complete stasis of lymph in this particular vessel as far back as the first anastomosing lymphatic. Along this the current will now pass, carrying with it other ova; these, in their turn, will be arrested at the first gland they reach. And this process of embolism, stasis of lymph, diversion of current into anastomosis, will go on until the whole of the lymphatic glands, directly or indirectly connected with the vessel into which the parent parasite ejects her ova, are rendered impervious, provided the supply of embolic ova is sufficient, kept up long enough, or renewed from time to time. The particular form of lymphatic disease, and the place affected, will depend on the position occupied by the parent worm, on the number of ova she ejects, on the frequency with which these miscarriages are repeated, and on the nature of the tissues involved, and individual peculiarities and accidents.'

The writer ventures to suggest that in some cases the lymphatic obstruction that gives rise to the various diseases associated with filarial infection may be caused by inflammation excited by the presence of the parent worms, without filarial abortion being a necessary step in the process. It may be further inferred that any condition which brings about mechanical obstruction of the lymphatics, of a lasting kind, will be followed by similar results, and thus may be explained what is known to occur, that the various diseases ascribed to the influence of filaria sanguinis hominis may happen without the presence of this parasite. Plugging of the upper group of the superficial inguinal glands, if anastomosis is not established, will give rise to 'lymph scrotum,' or to elephantiasis of the scrotum. If the lower group of these glands is obstructed, elephantiasis of the lower extremity may result, the two affections, from the intimate connections of these two groups of glands, being frequently associated. Where the lumbar glands are affected the lymphatics of the spermatic cord may be involved, and hydrocele, simple or milky, be caused. Chyluria or lymphuria will result when the lymphatics of the bladder, ureters, or kidneys are occluded (*see* CHYLURIA). In many of these conditions, besides chyluria, the over-distended lymphatics rupture and a discharge takes place, lymphous if no regurgitation from the lacteals occurs, chylous if such regurgitation takes place.

Prevention of the diseases attributable to filarial infection.—Whilst the exact mode of entrance of the filaria has not been established, it will be seen that in all probability it is through the medium of drinking-water. Preventive medicine may therefore be of signal service in lessening or stamping out the diseases due to this cause, by insisting that all water used for drinking purposes be filtered, or, better still, boiled.

Filariæ are not confined to the blood of man. *Filaria immitis* is very common in dogs in China, Japan, and India, and other carnivora are known to be similarly affected. Many birds also have filariæ in their blood. The common ringed crow and magpie of China are frequently infested, the parent worms being found in the pulmonary artery or valves of the heart.

STEPHEN MACKENZIE.

FINGER-CHANCRE.—Chancres may occur on any part of the body, and they are unfortunately of not infrequent occurrence on the fingers of those engaged in midwifery practice. A chancre on the finger, whatever may have been its source of origin, often presents throughout its course very deceptive appearances. As a matter of fact the true nature of these sores is but seldom recognised until the constitutional symptoms appear. In some cases this is due to the very slight amount of inflammation which attends them, but in a majority to its excess. It is probable that the finger is seldom inoculated unless there has existed previously some sore or abrasion. Their most common seat is the nail-bed, producing there what may be termed the 'whitlow-chancre.' There is nothing in their early stages to distinguish them from the sores due to common inflammation. They are attended by much dusky swelling of the end of the finger, considerable suppuration, and great pain and soreness. At no stage is there any characteristic induration. The nail often becomes loose, and may be shed or removed by the surgeon. If treatment be adopted early, however, the nail will usually be in part at least preserved, but it often remains ever afterwards rugged and thickened.

In making the diagnosis of finger-chancres the examination of the lymphatic glands is of great importance, but of course does not afford conclusive evidence, since indolent enlargements of them may occur in connection with other sores than those of syphilis. The stages of chancres on the fingers are the same as those of chancres on other parts, and the conditions are just as variable in individual cases. It is not uncommon for the period of incubation (four to five weeks) to pass over without any sore being noticed, but in other cases inflammation in varying degree may be present from the first. Now and then a finger-chancre when not implicating the nail-bed may present, even when at its height, nothing more than a dry dusky and scaly patch, and in these cases the axillary bubo may be omitted or be but very slightly marked. It is in such cases almost impossible to make the diagnosis before the appearance of the secondary rash.

Chancres may of course occur on other parts of the hand besides the fingers, but they are very infrequent. The writer has seen them more than once in the middle of the palm; and here, as on the face and some other parts, they occasionally assume extraordinary dimensions. Thus in one instance almost the whole of the palm of the hand of a policeman, who had been injured in a scuffle, was occupied by a chancre.

Although in a very large majority of cases a finger-chancre is also a 'midwifery chancre,' yet it is of course to be understood that this is not always so. A surgeon's finger may be inoculated in the performance of an operation, or in making a dressing or examination. We also now and then see professional chancres on the fingers of dentists and policemen; whilst in a yet smaller proportion they are met with, either from improper practices or as mere matters of accident, on the fingers of those whose occupations are not attended by any special risk.

For further information concerning erratic chancres in general, the reader is referred to SYPHILIS.

JONATHAN HUTCHINSON.

FINGERS, Amputations of the.—The soundness of what has been designated 'conservative' surgery receives ample illustration in connection with this group of amputations, the principle being the removal of as little of the limb as is compatible with the patient's safety and convenience. The preservation of even one or two fingers is of the last importance to the patient, from his being able to accomplish more with them than with the most elaborately constructed artificial hand. The wounds, too, owing to the great vascularity and inherent vitality of the parts, usually heal with exceptional rapidity.

The amputations of the fingers may be divided into three groups:—(*a*) The phalangeal; (*b*) the metacarpo-phalangeal; and (*c*) the carpo-metacarpal amputations.

The PHALANGEAL amputations may be done either between or through the articulations, or in the 'continuity' or 'contiguity' of the phalanges. The amputations performed through the articulations or in the contiguity, are those more frequently selected, and are done by a short posterior, and a long anterior or palmar, flap. The operation is performed in one of two ways. In the first, the hand is pronated, and the neighbouring fingers being separated and held asunder, the surgeon seizes the portion of the finger to be removed, and forcibly flexes it on the proximal phalanx. The articulation is then easily opened by directing a narrow-bladed scalpel or bistoury across the front of the joint. The operator can facilitate the procedure by pressing the tissues forward with his left index-finger, kept behind the part to be removed. Having divided the ligaments in front and at each side of the joint, and freely opened into it, the scalpel is brought well behind the phalanx and close to the bone, and an anterior or palmar flap of sufficient length is made by cutting from behind forwards. The articular surface of the proximal phalanx should then be removed with either a fine saw or, better still, by a bone-pliers. All bleeding vessels should be secured, and the palmar flap brought up and secured to the edge of the dorsal incision by two or more points of interrupted suture.

Another method consists in making the palmar flap in the first instance by transfixion, the hand being supinated. The articulation is opened into in front, and a short dorsal flap is then formed. The first-mentioned method is decidedly to be preferred. These operations are equally applicable to the amputation of the terminal and second phalanx; the great merit of the procedure being its facility, the ample covering for the bone that is obtained, and that the cicatrix, situated on the dorsal aspect of the finger, is not liable to be injuriously affected by pressure. When possible, amputation in the continuity of the second phalanx is to be preferred, with the object of preserving muscular attachments, and a consequent power of motion in the first phalanx.

Amputations in the continuity are applicable both to the first and second phalanges. They may be done either by antero-posterior flaps of equal length, or by lateral or circular flaps. The first-mentioned is the one most usually selected. The hand being prone, the operator grasps the finger to be removed, and with a narrow-bladed scalpel or bistoury makes a lunated incision over the dorsal aspect of the finger, and a flap from a quarter to half an inch in length. A palmar flap, somewhat longer than the dorsal, should be made by transfixion. The bone is then cleared and divided, either with a fine narrow-bladed saw or preferably with a cutting pliers. The method by lateral flaps is mainly applicable to amputations of the first phalanx, and may be made either by transfixion or dissection. In this operation the surgeon must exercise his own judgment as to the removal or not of the head of the metacarpal bone. As a rule the writer prefers removing it.

The operation best adapted for the next group of digital amputations, METACARPO-PHALANGEAL, is the 'oval' method, so called in consequence of the wound made being somewhat of an oval shape. It consists in making an incision on the centre of the dorsal aspect of the metacarpal bone, commencing a few lines behind the point where the bone is to be divided. The knife, on approaching the head of the metacarpal bone, should make an oval sweep round the finger, following in so doing the natural somewhat transverse crease or groove on the palmar surface, great care being taken to avoid wounding the web of the fingers, the formation of any palmar cicatrix being most undesirable. The tissues on, and at each side of, the bone, are then divided, care being taken not to open into the articulation with the first phalanx. Another point of importance connected with amputations of the fingers with portions of their corresponding metacarpal bones, is in reference to the way these latter are divided. If the 'ring' or the middle finger be operated on, the bone should, as a rule, be divided horizontally in a line at right angles to its axis. If, on the other hand, the fifth or little finger, or, again, the 'index' finger be operated on, the division of the bone should be made obliquely, in order to prevent deformity and the pressure of any sharp edge of bone on the integuments covering them. In dividing the metacarpal bone of the little finger, therefore, the division should be obliquely from behind forwards and inwards, and the direction should be reversed in operating on the index fingers.

Carpo-Metacarpal Amputations. — With the exception of the amputation of the thumb, these amputations are seldom performed, for the sufficient reason that the operations involve opening the synovial membrane of the wrist, an occurrence which—no matter how careful the antiseptic precautions taken may be—is fraught with considerable peril to the joint.

Amputation of the *thumb* is, of all the amputations on the fingers, the one which the surgeon should be the least disposed to perform. It is only in cases of the most urgent necessity that it should ever be undertaken. The reason for this is that of all the digits it is the one the preservation of which is most important for the patient. By some of the older French authors, it has been well termed *le petit main.* The complete removal of it, therefore, with its metacarpal bone, should be regarded in the light of a *dernier ressort.*

It may be performed in one of three ways:—(1) the oval method; (2) the method of transfixion; and (3) the method of 'direct incision,' i.e. separating the thumb from the other fingers, thus making the web tense, and then dividing this by cutting directly down through it, keeping close to the metacarpal bone until the articulation with the trapezium is reached. This joint is then opened, and the bone disarticulated. A lateral flap is then made by getting the knife behind the bone, and cutting a flap from behind forwards. The great disadvantage of this operation is that a long and often painful palmar cicatrix is left. In fact, the operation has little to recommend it, with the exception of the rapidity with which it can be performed.

The oval method is performed in a manner similar to that already described in connection with the metacarpo-phalangeal amputations. The procedure is one which, though it necessarily takes a much longer time for its performance than the other methods, still is one which, as a rule, is attended with very satisfactory results. The wound made in this operation is not so extensive as in the method by direct incision, and it has the additional merit of there being only one cicatricial line, and that far removed from the palmar surface.

The third and last method deserving of mention is that known as the one by transfixion. It is performed with a small catlin. An oblique incision is made along the posterior aspect of the thumb, dividing integument, long extensor, and a portion of the first interosseous muscle. The incision commences at the centre of the commissure, and extends to a point terminating in front of the styloid process of the radius. Here transfixion of the tissues forming the 'ball' of the thumb occurs, the point of the instrument being made to enter at the termination, and emerge at the commencement of the oblique dorsal incision. The flap is then made by dividing the tissues from within outwards, keeping close to the metacarpal bone.

The capsule of the joint is opened, the bone dislocated and removed. This operation is also performed by reversing the steps of it as already indicated, making the transfixion flap in the first instance, and the oblique dorsal incision afterwards. The procedure is a slight modification of the procedure described by Velpeau.

The oval method is, in M. Guérin's opinion, from every point of view the one to be preferred, and in this the writer is disposed to coincide. The same opinion may also, he thinks, be given as regards amputation of the little finger with its metacarpal bone. This operation is performed in two ways:—(1) the flap method (Lisfranc), and (2) the oval. The former of these is performed by making a flap by transfixion by means of a full-sized triangular bistoury, which is the instrument usually employed. It should be inserted, Malgaigne observes, opposite the ulnar side of the joint perpendicularly from the dorsal to the palmar surface, and a semi-elliptical flap formed by cutting from behind forwards. The knife, keeping close to the bone, should divide the interosseous tissues, cutting from behind forwards to the digital commissure. The joint should then be opened, and the bone dislocated. On making traction of the finger, the ligamentous and muscular tissues, as yet undivided, are made apparent and incised by a few touches of the point of the bistoury. A simpler and better method—that by direct incision through the web of the finger and interosseous space—has been thus described by Mr. Heath: 'The finger being drawn away from the hand, the knife, held at right angles to the finger and with its point upwards, is made to cut through the web of the finger and interosseous space until it reaches the base of the metacarpal bone. This is somewhat expanded, and the knife must be turned outwards slightly to open the joint, when forcible traction of the finger will dislocate it. The knife is then passed round the base of the metacarpal bone, and brought out with the edge forwards, cutting a flap from the ulnar side of the finger, rather longer than the exposed surface, in order to allow for shrinking.'

In the writer's opinion, for amputations in the contiguity of the phalanges, the method by a short posterior and long anterior flap is to be preferred; in amputations in the continuity, antero-posterior flaps of equal length; and in metacarpo-phalangeal and carpo-metacarpal amputations, the oval method should be the operation selected. WILLIAM STOKES.

FINGERS, Congenital Deformities of the.—The more common among the congenital deformities of this region range themselves naturally into two classes—namely, those of excess and those of deficiency. In a very large proportion of instances there is some history of inheritance, and the story, when accurately to be obtained, is often of considerable interest, and may show the existence of similar, though not always identical, deformities in many generations. Extra digits are among the most frequent of all aberrations of type occurring congenitally. Every variety is to be met with, from a small piece of flesh resembling the last phalanx and provided with a rudimentary nail, which is attached by a minute thread of skin to some portion of the outer side of the thumb or the inner side of the little finger, to the perfectly developed digit or digits provided with an additional metacarpal, and even in some cases an extra carpal bone. Sometimes such fingers have special tendons and are accommodated with an efficient vascular system. More commonly, however, their usefulness is very slight and their nourishment but imperfect. The condition may be unilateral or symmetrical, and additional toes may co-exist in the same individual. These are the two extremes of the deformity, but intermediate conditions are frequent, as when an extra phalanx articulates with the distal end of the second phalanx, or where an additional finger articulates by a common joint with the metacarpal, which is then expanded at its extremity, or, in some cases, bifurcated, Where a separate articulation exists it is usually placed below the normal articular surface of the metacarpal or phalangeal bone. Sometimes—and this is especially frequent in the case of the thumb—the extra digit is intimately united along its whole length with the normal finger, and the two move and act freely together.

On the side of deficiency there is met with again every gradation of variety. A finger may be represented by a single phalanx, or all the fingers of the hand, and even the hand itself, may be absent. The thumb, although less often deficient, may be only partially represented, and the little finger, though less frequently absent than others, is often only rudimentary. Not uncommonly all the parts on the ulnar side of the hand may be unrepresented, together with the corresponding metacarpal, and even carpal, bones, and in such cases more or less deficiency of the ulna itself will be detected. The same condition is found, though not so frequently, on the radial side. These cases must be distinguished from those of so-called intra-uterine amputation, which may occur at any part of the hand or arm, though even in these some representative of a digit is very commonly discovered.

Treatment.—The only remedy which may be called for in cases of extra digits is to amputate the part which is excessive and useless. In doing so, it should be remembered that there is usually a common articulation to both the normal and abnormal portion, and, therefore, that it may be impossible to avoid opening the synovial membrane of the former. Even the smallest skin attachment transmits an artery which will require careful ligation. No portion of bone should be left behind, as this will inevitably grow and cause an unsightly and inconvenient prominence. *See* WEBBED-FINGERS. JOHN H. MORGAN.

FINGERS, Dislocations of the. *See* HAND, Dislocations of Bones of the.

FINGERS, Fractures of the. *See* HAND, Fractures of Bones of the.

FISSURE OF THE ANUS.—The affection of the anus usually known by this name is really an ulcer of the mucous membrane, at or immediately above the margin of the anus. The ulcer is somewhat oval, with the vertical diameter greater than the transverse. When the sphincter muscles are contracted, the ulcer is bounded on each side by a projecting fold of swollen and, in chronic cases, indurated mucous membrane, and so resembles a fissure. When the orifice is dilated, the true nature of the case is evident. The lower end of the ulcer is, in many cases, overlapped by a protuberance of mucous membrane, which resembles, and is sometimes mistaken for, a muco-cutaneous pile. The ulcer is generally situated on the posterior wall of the anus, and occurs more frequently in females than in males. It is comparatively rare in children.

A sedentary life, congestion of the rectum, and constipation are predisposing causes. It sometimes results from parturition. During the passage of the child's head through the vulva, the margin of the anus may be slightly lacerated, and the subsequent irritation of the lochial discharge may cause ulceration. Catarrh of the rectum—whether simple or caused by a polypus, internal piles, or a fistula, or, in women, vaginal discharges—may cause excoriation and subsequent ulceration of the margin of the anus.

The symptoms vary in different cases. Some patients feel merely some irritation or uneasiness during the passage of a motion. In others, defecation is attended with excruciating pain, which may last for several hours. Not infrequently there is intense spasm of the sphincter and levatores ani muscles. The muscles at the neck of the bladder may be similarly affected, and so produce retention of urine. In patients of irritable nervous temperament, this apparently trifling ulcer may cause unceasing torment, and the sufferers complain, not only of local distress, but also of pains in the lumbar and sacral regions, and down the thighs. The anatomy of the part explains these symptoms. The submucous tissue of the rectum is abundantly supplied with a nervous plexus, the terminal branches of which end in the papillæ and epithelium of the mucous membrane. When the surface is ulcerated, these nerve-terminations are exposed, and, when irritated by the passage of fæces, or by mucous or purulent discharges, or even by the tension produced by the contraction of the muscles of the part, may induce reflex spasms and local or referred sensations of pain. As some of these symptoms occur in so-called neuralgia of the rectum, the diagnosis can only be assured by inspection of the part. For this purpose, if there be much spasm, or if the patient be very sensitive, anæsthesia must be induced. The orifice being then dilated by the fingers of the surgeon, or by a Fergusson's speculum, the ulcer, if present, will be seen. The rectum should be carefully examined, to ascertain whether there are any complications, such as catarrh, polypus, piles, or fistula. If there be any of these, or if, in women, there be a vaginal discharge, the complication must be appropriately treated as well as the ulcer.

For the ulcer itself, if it be recent and the symptoms not severe, cauterisation with solid nitrate of silver, and the subsequent application of iodoform in powder, or as an ointment, will usually suffice. If this treatment fail, or if the ulcer be chronic or the symptoms severe, operative treatment will be required. The bowel having been previously emptied, the patient should, if necessary, be anæsthetised, and placed in a suitable position, the lithotomy position being usually the most convenient. The orifice having been dilated by the fingers of an assistant, or by a Fergusson's speculum, a vertical incision should be made along the centre of the ulcer, extending into the healthy tissues above and below it. Any overlapping protuberance of mucous membrane, at the lower end, should be excised. By this incision the mucous membrane and the superficial fibres of the sphincter muscles should be divided. The ulcer may then be dressed with cotton wool steeped in carbolised oil, and subsequently with iodoform. The patient should maintain the recumbent posture, and the bowels be kept at rest for some days. About the fifth day some castor-oil should be administered, to produce an easy action of the bowels. The ulcer usually heals rapidly by granulation, but may require some stimulating application, such as dilute nitrate of silver lotion.

It was at one time considered necessary to completely divide the sphincter muscles. In order to avoid this needlessly formidable operation, the practice of forcible dilatation was adopted. The surgeon having introduced both thumbs into the bowel, resting his fingers on the nates, then separated his thumbs until they came in contact with the ischial tuberosities. By this means the base of the ulcer was torn across. This practice was given up when it was ascertained that superficial division of the sphincters sufficed. It has been recently revived by some surgeons, but does not appear to have anything to recommend it in preference to the limited incision above described. Jeremiah McCarthy.

FISTULA IN ANO.—This is a sinus in the neighbourhood of the anal part of the rectum, of which three varieties have been distinguished:—The Complete, opening into the bowel internally, and on the perineum externally; the Incomplete External, opening on the perineum but not into the bowel; and, the Incomplete Internal, opening into the bowel but not on the perineum. The second and third varieties are very rarely met with, and the diagnosis of the second should only be made after careful examination, as the internal opening may be small, and concealed by a fold of mucous membrane; or the sinus may travel round the rectum, in the so-called 'horse-shoe' form, and open on the wall of the bowel remote from the perineal aperture. If an internal opening cannot be detected in the ordinary way, by the passage of a probe into the sinus with one hand, and of the opposite forefinger into the bowel, the patient should be placed in the lithotomy position, and a Fergusson's speculum introduced into the rectum, with the slit directed towards the wall of the bowel adjacent to the perineal opening of the sinus. Some milk should be injected, under moderate pressure, into the sinus; and if none pass into the bowel, while the injection is still continued, the speculum should be slowly rotated so as to bring the slit successively opposite to all parts of the circumference of the bowel. Then, if milk pass into the bowel, an internal opening will be discovered, which might otherwise have been unnoticed, or, on the contrary, the absence of any opening can be satisfactorily ascertained.

Cause.—Anal fistulæ result from suppuration of the peri-anal connective tissue. This may be due to perforation of the mucous membrane by some foreign body, such as a fish-bone, or by ulceration. It may also occur without any lesion of the mucous surface, possibly in connection with the lymphatics, or blood-vessels, or glands of the part. If a free opening be made in the perineum as soon as fluctuation can be detected, the wound will probably heal without further trouble; but if the abscess be neglected, as is often the case, since it causes little pain, it will ultimately point and open in the perineum, generally on one side of the anal orifice, but sometimes in front of or behind it. The abscess-cavity then contracts, but cannot close completely from the constant traction of the anal muscles. The internal opening, if not already existing, will form subsequently, and if the contents of the bowel can pass into the fistula, healing will be still further prevented. The inner opening is usually at some point within the limits of the internal sphincter, which extends upwards to about one inch from the orifice. The inner opening is very rarely higher than this, and in the majority of cases will be found close to the margin of the anus. The channel connecting the openings may be straight or tortuous. It sometimes passes round the bowel, as the so-called 'horse-shoe' fistula. In chronic cases secondary sinuses often form, which may ramify in any direction, so that there may be more than one perineal or internal opening.

Symptoms.—Anal fistulæ are painless, so long as the discharge can escape freely. If the external opening become occluded, the part will inflame; but the patient is chiefly inconvenienced by the surrounding parts being kept always moist and soiled by the discharge. The discharge itself may vary in quantity and character, being scanty or abundant, serous or purulent, according to the patient's general condition and the irritability of the part. Sometimes flatus, or even fæces, pass by the fistula, especially if the inner opening be large.

Diagnosis.—All perineal fistulæ in the neighbourhood of the anus are not necessarily connected with the anus. They may be due to stricture of the rectum, or to necrosis of the sacrum or coccyx, or to stricture of the urethra, or to disease of the prostate gland. The history of the case, the direction of the sinus, and examination of the surrounding parts, will sufficiently distinguish these from an anal fistula. In chronic cases the perineal opening is usually marked by projecting granulations, but in recent cases this indication does not exist, and the surgeon may have to search closely for the orifice, if it be small and concealed by folds of skin round the anus. The direction and extent of the fistula may be ascertained by the cautious use of a probe, and injection, as above described, may, if requisite, be used to discover the internal opening.

Treatment.—The only curative treatment that can be recommended is complete division of the structures between the fistula and the anus. This may be performed as follows:—An aperient should be administered the evening prior to the operation, and if the patient be a male adult, the perineum should be shaved. The patient should be placed on the side corresponding to the fistula, with the thighs flexed or in the lithotomy position. If the fistula be recent and simple, and the patient not very sensitive, an anæsthetic will not be requisite. But in chronic cases, where secondary sinuses may be present, the operation can be performed more satisfactorily if the patient has been anæsthetised. The direction of the fistula having been previously ascertained, a suitably curved director should be introduced through the perineal orifice, and brought out at the anus. A sharp-pointed bistoury, passed along this, should then be made to cut through all the intervening structures.

The angles of the wound, and any undermined skin or mucous membrane, should be excised, and an incision made with a scalpel along the upper wall of the fistula, to divide the callous cicatricial tissue which forms the boundary of it. Secondary sinuses, if superficial, should also be laid open. Sometimes a sinus will be found to extend upward by the side of the rectum. If this be in the submucous tissue, the undermined mucous membrane should be divided. This can be conveniently done with blunt-pointed scissors, one blade being passed up the sinus, and the other up the bowel. But this division must not be carried out of sight and reach of the operator for fear of hæmorrhage. If the sinus extend farther than this, and division be considered requisite, it may be effected by a galvanic or elastic loop.

If the sinus be in the peri-rectal connective tissue, division is unnecessary, as it will close when a free outlet for the discharge has been made. It may, with advantage, be injected with tincture of iodine, diluted with an equal quantity of water. The wound should be carefully packed with cotton-wool, and any oozing of blood can be controlled by the pressure of a pad of lint and a T-bandage. The bowels must be kept inactive for some days. About the fifth or sixth day some castor-oil, or similar laxative, may be administered, and afterwards a daily, easy action of the bowels insured. After each motion the wound should be thoroughly syringed. The wound may be daily filled with cotton-wool, and the compound tincture of benzoin, or nitrate of silver, five grains to the ounce, may be applied with advantage; but many surgeons are content to have the wound syringed out only with a stimulating lotion, thus obviating a daily painful proceeding. The patient must maintain the recumbent position until healing is completed, which usually occurs in about six weeks. Sometimes, however, the process is very tedious, and change of air and sea-bathing may prove of service. As a rule, however, a surgeon will act more wisely in insisting on complete rest, and keeping the patient under his personal supervision until the cure is completed.

Phthisical patients are very subject to anal fistulæ. If the pulmonary disease be far advanced, any operation would be useless. Otherwise the tubercular diathesis need not be any bar to the operation, as the patient's general health will probably be benefited if the fistula can be healed. But in such cases healing is especially tedious, and, in order to prevent disappointment, the patient should be warned of this beforehand.

The Hippocratic treatment of anal fistula by ligature has been recently revived by some surgeons. It has the great advantage of not interfering with the patient's ordinary avocation, but is only applicable in recent and uncomplicated cases. It is unsuitable if there be secondary sinuses, and as these are usually only discoverable when the primary fistula has been divided, the number of cases in which the ligature can be employed with advantage is very limited. The ligature may be inelastic or elastic. If the former, the ligature—whether of silk, whipcord, or silkworm gut—should be passed through the fistula by means of an eyed probe, and then, the probe having been withdrawn, the ligature should be tied so as to constrict the tissues, but not so tightly as to excite inflammation. It should then be drawn tighter daily, or every second day, until it shall have cut through the tissues, and the resulting wound should be dressed with cotton-wool in the ordinary manner. This was essentially the method employed by Hippocrates, who used a five-fold ply of undressed flax corded with horsehair, as a ligature. If the flax became corroded before its task was accomplished, more flax could be attached to the horsehair, and so drawn through. In order to avoid the repeated tightening of the ligature, an india-rubber band of suitable strength may be passed through the fistula, and the tissues at once adequately constricted, the ends of the ligature being either knotted or clamped.

The ligature, whether elastic or inelastic, takes from six to fourteen days to cut through the tissues, and sometimes causes severe inflammation, so that even in the simplest cases, if the patient can afford the requisite time, division by the knife is the preferable procedure.

Sometimes, but very rarely, anal fistulæ heal spontaneously. In cases of incomplete external fistulæ, examination of the mucous membrane of the bowel with a speculum will sometimes disclose a punctured cicatrix, corresponding to what had been the internal opening of a complete fistula. If there be a free outlet for the discharge, the rest of the channel may also close. This result may be aided by dilatation of the perineal opening with laminaria. But the process is tedious, and the benefit often illusory, since the fistula, even if it should close, is prone to recur. This mode of treatment should therefore only be adopted when, from the general condition of the patient, operative treatment is impossible.

Incomplete Anal Fistulæ.—In the external variety, a director should be thrust through the thinnest part of the undermined mucous membrane of the bowel, and the case treated as one of complete fistula. In the internal variety, a curved director should be passed into the sinus, which should then be laid open down to the perineum, and the resulting wound dressed in the ordinary manner.

Jeremiah McCarthy.

FLAT-FOOT.—*Definition.*—A falling down or giving way of the normal arch of the foot, which may be so slight as to be scarcely noticeable except from the discomfort it causes, or so severe that the inner malleolus touches the ground, with the outer border of the sole raised.

Causes.— Flat-foot is directly due to weakness of the leg-muscles, which pass in front of and behind the inner malleolus into the sole of the foot. Infants on commencing to walk are normally flat-footed and without any arch to the feet; after running about for a few months, a perfect arch is formed when the muscles of the leg have become sufficiently developed. Anything that weakens the patient generally tends to produce flat-foot, as too rapid growth, the occurrence of acute fevers, &c. Infantile paralysis of the leg produces flat-foot as soon as the patient begins to walk. The writer finds that two out of every three patients with lateral curvature of the spine have flat-foot of varying degrees of severity. Flat-foot is intimately associated with knock-knee, and the one may induce the other, or both may commence simultaneously. Injury or chronic disease of one leg, throwing extra work on the sound limb, will frequently induce flat-foot in the latter.

Pathology.—When flat-foot is due to general muscular weakness, there is at first a simple relaxation of the tarsus with slight displacement downwards of the scaphoid, which can be easily replaced when the feet are taken off the ground, or by standing with the heels raised. In time, the scaphoid becomes more and more thrust inwards and downwards till it is partially dislocated; this sub-luxation is accompanied by more or less displacement of the inner cuneiform bone and the astragalus. The articular surfaces of the scaphoid and adjacent bones become so altered that complete replacement is no longer possible. When the tarsus has become so distorted, the muscles of the leg and sole may in time recover their strength, but are unable to restore the depressed arch of the foot. While the muscles are weak and unable to support the plantar arch, undue pressure and tension are thrown upon the ligaments and tendons in the foot, which become irritated and painful. In some cases, so much irritation is produced that the articulations between the scaphoid and the inner cuneiform in front and the astragalus behind become inflamed, and ankylosis results.

Symptoms.—As already mentioned, flat-foot is a very general term and includes everything from a slight relaxation of the plantar arch to extreme cases where the internal malleolus touches the ground, as in some cases of infantile paralysis. In severe cases there may be scarcely any pain or discomfort, except that of wearing down the inside of the boot in an unusual way, which may be accompanied by a sort of waddling gait in walking; while a patient with but very slight flat-foot may suffer constant severe aching or acute pain over the whole inner aspect of the plantar arch, extending upwards over the dorsum of the foot and frequently even up the legs to the knee or beyond.

Treatment.—With a view to treatment cases of flat-feet may be divided into three groups :—

(1) Cases in which it is possible to restore the foot completely to the normal shape by passive manipulation, without any decided force being employed.

(2) Cases in which the tarsal bones have become more or less fixed in their displacement by fibrous ankylosis, shortened ligaments or osseous deformity, and which require operative interference under anæsthetics.

(3) Intermediate cases, in which *partial* restoration of the normal plantar arch is possible by passive manipulation. Groups (1) and (3) require (*a*) the restoration and maintenance of the previously depressed plantar arch, and (*b*) the strengthening and approximation of the parts that support the normal instep.

(*a*) Boots really shaped to the form of the feet should be worn, made from an outline drawn round the foot while the patient is standing with the toes, especially the great one, well spread out inside the stocking, so that the inner margin of the foot is nearly straight and parallel with that of its fellow. It is essential that the outer portion of the sole should also touch the ground through the boot, which in all severe cases should be made without a heel, and with the ‘waist’ stiff, since the chief motion of the foot during walking takes place at the metatarso-phalangeal articulations, and not in the arch of the foot. A wedge-shaped pad, with the straight side forming the base, and corresponding in size to the normal hollow of the plantar arch, is fixed inside the boot. The best materials for the pad are superimposed layers of felt or horsehair, firmly packed in a suitably shaped leather case. Steel springs or solid india-rubber pads cause too much discomfort, if they be fairly brought against the depressed plantar arch. In no case is the pad to extend right across the 'waist' of the boot, as this at once interferes with the normal transverse plantar arch. The boot being made without heel, the pad has the same effect in it as on the ground. The boot must be laced, as the pad, to be efficient, should be well braced up against the plantar arch. In more severe cases, if the foot still treads over, it is necessary to have, in addition to these properly made boots, an outside leg-iron to below the knee, fixed to the boot, with a triangular leather band on the inside, attached to the sole and fastened round the iron. Where possible, these irons should be avoided, as they interfere so much with the use of the feet.

(*b*) To strengthen and approximate the parts that support the plantar arch, systematic exercise is most useful. Walking forwards and backwards bare-footed on the toes, with the heels moderately raised, for 100 steps, several times daily, is easily carried out and is very efficient; so also is walking on the outside edge of the feet, with the soles directed inwards and slightly forwards.

Anything causing cold feet must be removed, such as tight garters worn above or below the knee, which should be replaced by suspenders attached to a band round the pelvis. The circulation of the lower extremities, if languid, must be promoted by extra clothing if necessary, and by warm baths, followed by rapid cold sponging and good friction in drying. If the leg muscles are very weak, massage for half an hour twice daily should be employed. *See* MASSAGE.

If any knock-knee is present, this should be corrected at the same time.

In group (2), where the displacement of the plantar arch is immovable, forcible breaking down of the adhesions under anæsthetics should be done, and the patient kept in bed for a few days, when the treatment advised for groups (1) and (3) should be applied. Severer operative measures, such as the removal of a wedge-shaped piece of bone from the tarsal arch under antiseptic precautions, do not appear justifiable to the writer, who has not yet seen a case which offered any reasonable probability of this treatment being of permanent benefit to the mutilated patient. *See* CLUB-FOOT (Talipes Valgus).

BERNARD ROTH.

FLOATING TUMOURS. *See* ABDOMINAL TUMOURS, Diagnosis of.

FOMENTATIONS.—A combination of heat and moisture, in the form of a fomentation, is one of the most soothing and at the same time one of the most efficient therapeutic agents which can be applied to inflamed parts. The tensive pain of inflamed parts is relieved, possibly by relaxing tissues and so reducing tension, whilst the severity and extent of the inflammation may be diminished and the formation of pus prevented. The beneficial effects of fomentations on cutaneous and subcutaneous inflammations are striking and apparent, but deeper parts, the internal organs, are not beyond the reach of their influence; they cause relaxation of spasm, as in renal and hepatic colic, and they influence inflammations, as in acute cystitis, orchitis, &c. When suppuration has taken place, fomentations are sometimes recommended, on the ground that they will hasten the advance of pus towards the surface; this is undoubtedly correct, but it is equally certain that the knife, rather than a fomentation, is to be recommended, for by its means the pus may be evacuated at once and further destruction of tissue arrested, whilst the natural process, accelerated as it is by fomentations, involves the breaking down of all the tissues lying between the abscess and the surface. But when the abscess has been opened, and the tension of accumulated matter removed, the inflammation will tend to subside, and then fomentations are very useful, as they hasten the resolution of the inflammatory products.

When the skin of the inflamed part is not broken, soft flannel, wrung out of boiling water, or spongiopiline, similarly treated, makes good fomentations, but if the inflamed area be also wounded, antiseptic fomentations are preferable; two or three folds of boracic lint or a thick piece of salicylic wool, steeped in boiling water, and thoroughly wrung out, make admirable antiseptic fomentations. Whatever material be used it must be covered over with a piece of oil-silk or macintosh cloth of larger size than itself, in order to retain the moisture, and this, again, must be covered with a thick layer of cotton wool, in order to retain the heat; the whole application should be fixed in position by some form of bandage, which is easily applied and easily removed without causing the patient much disturbance. For the limbs the many-tailed bandage is the best. The external covering of cotton wool is most important, for without it the heat of the fomentation would be quickly lost, and even with it the loss is so rapid that it is desirable that fomentations should be changed every hour or two hours.

Fomentations should be wrung as dry as possible, for they can then be borne by the skin at a higher temperature than when the moisture has not been so thoroughly expelled.

To make a fomentation the cloth should be placed in a 'wringer,' consisting of a piece of stout towelling with a rod at each end, and boiling water poured over it into a basin; the fomentation should then be squeezed dry by twisting the rods in opposite directions; in the absence of the wringer an ordinary towel answers very well. The fomentation should be carried to the patient in the wringer and at once applied.

Fomentations are often used as vehicles for applying other therapeutic agents; thus, if a strong counter-irritant effect is desired, 20 or 30 minims of turpentine may be sprinkled on the fomentation; if an anodyne effect be required, one or two drachms of the tincture of opium or belladonna may be sprinkled on the fomentation, or equal parts of the extract of belladonna and glycerine may be first smeared over the inflamed part, and then the fomentation be applied. In some cases the effect of heat without the relaxation of tissue produced by an ordinary fomentation is desired, and then bran, chamomile heads, or sand heated in a pan over the fire and poured into suitable bags, may be applied over the affected parts. These applications are especially effective in relaxing muscular spasm and relieving its attendant pain.

Bilton Pollard.

FOOT, Amputations in the.—Much of what has been already said in reference to the methods of amputating the fingers, applies equally to the corresponding operations on the toes. Partial amputations, excepting that of the great toe, are seldom, if ever, performed, the stumps resulting being short, useless, and inconvenient, from their tendency to upward projection. The distal phalanx of the great toe is, however, occasionally removed; but it is important to preserve as much as possible of the great toe, so much of the weight of the body being thrown upon it. Previously to the operation, it is desirable to render the part anæmic by the application of an Esmarch bandage. An assistant then draws aside the adjacent toes by means of a loop of bandage over them; and the surgeon, forcibly flexing the distal on the proximal phalanx, makes a transverse incision with a narrow-bladed straight bistoury or scalpel, exposing the joint. Continuing the forcible flexion, the knife is inserted behind the distal phalanx and a plantar flap is cut from behind forwards. Amputation in the continuity of the first phalanx can be done either by the circular, or by antero-posterior or lateral flaps made by transfixion. The latter plan is the one the writer prefers, as there is less risk of a plantar cicatrix. The bone should be divided with a pair of cutting pliers. For the metatarso-phalangeal amputations, the oval method, as already described, is the one most suitable. In the amputation of the great toe, it must be borne in mind that owing to the size of the head of the metatarsal bone, care should be taken to make ample provision for covering it, and that this can best be done by bringing the oval incision well on to the first phalanx.

In cases where the removal of the metatarsal bone of the great toe is indicated, it is well, in order to preserve the insertion of the peroneus longus, if possible, not to disarticulate, but to divide with cutting-pliers or saw, which should be done obliquely, to prevent any angular projection of the edge of the bone. In operations on the toes the surgeon must remember that the joints are more deeply situated than the corresponding articulations in the fingers. The following points should be observed in complete or partial amputation of the toes:—(1) All methods of amputation should be rejected from which a plantar cicatrix may result; (2) the most suitable method in the amputation of all the phalanges is by two curved incisions—a dorsal and a plantar—by which means the largest available amount of integument can be obtained to cover the heads of the metatarsal bones; (3) in the metatarso-phalangeal amputations the oval method should be adopted, and the dorsal incision should be commenced well behind the point where the bone is to be either divided with a cutting-pliers or disarticulated; (4) in this particular group of amputations, disarticulation should be, if possible, avoided, and this is especially important in dealing with the great toe; (5) in dividing the metatarsal bones, let those of the great and little toe be cut obliquely, to avoid any sharp projection of the edge of the bone against the skin; and (6) let the comparatively greater depth of the joints of the toes than of those of the fingers be borne in mind.

AMPUTATIONS THROUGH THE TARSO-METATARSAL ARTICULATION.—The method now preferred is that of Lisfranc, which is an improvement on the somewhat complicated procedure of Mr. Hey, of Leeds. Lisfranc, having determined the line of the incision, which is taken from a point immediately behind the spur of the fifth metatarsal bone, on the outside, to a point behind the projection at the base of the metatarsal bone of the great toe, on the inside, makes a curved incision with a strong scalpel, which should reach to a point three-quarters of an inch below the centre of the line corresponding to the articulation, its convexity directed forwards from one point to the other. The incision should not be brought lower down than the point indicated, otherwise the cicatrix would be drawn too far back on the face of the stump, owing to the retraction of the plantar flap. In this incision the integument alone is divided. A second incision made a little behind the first, and on a level with the retracted skin, divides the extensor tendons and dorsal ligaments over the articulations of the 5th, 4th, and 3rd metatarsal bones, assuming the operation to be on the right foot. In continuing this incision to divide the interosseous ligaments, since the 2nd metatarsal is wedged in between the internal and external cuneiform bones, its position must be borne in mind in disarticulating. The joint between the 1st metatarsal and internal cuneiform bone is then opened, thus completing the disarticulation. The interosseous ligaments being freely divided, two lateral incisions are made from behind forwards, their length corresponding as nearly as possible to half the circumference of the foot at the tarso-metatarsal articulation. Grasping the condemned portion of the foot, the surgeon forcibly extends it and cuts the plantar flap from behind forward, keeping as close as possible to the bone. In forming the flap, its edges should be sloped in order to facilitate subsequent adaptation. The vessels requiring ligature are the dorsalis pedis and the plantar arteries. Hæmorrhage having been arrested, the edges of the wound are brought together by means of numerous points of interrupted suture.

Of the foregoing operation an account of a modification practised by the late Prof. R. Wm. Smith was published by the writer some time ago, in which he claimed as an advantage the preservation of the two anterior points of support—namely, the ball of the great toe, and the base of the 5th metatarsal bone. The importance of this is obvious. The operation is performed by making an oblique incision across the four lesser metatarsal bones, commencing about three-quarters of an inch in front of the base of the 5th metatarsal bone, and in a direction towards the metatarso-phalangeal articulation of the great toe. The incision should be made down to the bones and another incision should then be made at the centre of the first one, but at right angles to it, upwards and inwards, for about an inch or an inch and a quarter. The tissues at each side of the second incision should then be dissected off the bones, and these, thus freely exposed, should be obliquely divided close to their proximal articulations with a small saw or fine forceps. The flap should be taken altogether from the sole of the foot.

In the case of a crushed foot, it would be best to dissect up such dorsal and plantar flaps as might be possible, and then to apply a saw at any convenient spot, either in the metatarsus or tarsus.

CHOPART'S MEDIO-TARSAL AMPUTATION. This operation is a disarticulation through the tarsus between the os calcis and cuboid on the one side, and the astragalus and scaphoid on the other. As guides to the articulation there are two landmarks—one, on the inside, a point immediately behind the tubercle of the scaphoid; and the other, on the outside, a point midway between the spur at the base of the 5th metatarsal bone and the external malleolus. These two points determined, the surgeon grasps and extends the foot, and making a lunated incision between them, carries it arched forwards three quarters of an inch below the articulation. The flap then is dissected back and the articulation opened. Two lateral incisions are next made, as in Lisfranc's operation, to guide the operator in forming the plantar flap, which is made by cutting from behind forwards and keeping quite close to the bones. It has been recommended to make the plantar flap first, which is done by cutting from without inwards, the flap extending to the heads of the metatarsal bones. Care should be taken to avoid a mistake sometimes made of confounding the articulation between the scaphoid and cuneiform bones with the astragalo-scaphoid joint. This is done by remembering that the articulation lies behind the tubercle of the scaphoid, and not in front of it. Professor von Langenbeck recommends preliminary tenotomy of the tendo Achillis, to prevent the retraction of the plantar flap bringing the cicatrix on the front of the stump; but if the plantar flap be made sufficiently long, as already described, there is no necessity for such a procedure. The arteries requiring ligature are the plantar vessels and the dorsalis pedis, as in Lisfranc's operation, and the same method is adopted of bringing the edges of the wound together by points of interrupted suture.

Other defects in Chopart's amputation have, it is stated, been observed; these are a tendency to eversion or valgus of the remains of the foot, to displacement of the heel upwards and backwards, liability to ulceration on the cicatrix, from its being drawn downwards on the face of the stump, and to the subsequent supervention of caries in the os calcis. These alleged defects of Chopart's operation the writer has not observed; though he can easily understand the probability of their occurrence if the plantar flap be not made of sufficient length. It is necessary to make allowance for the retraction of the plantar tissues which takes place to a greater or less extent after Chopart's operation.

William Stokes.

FOOT, Dislocation of the. *See* Ankle, Dislocations at the.

FOOT, Dislocations of Bones of the. Cuboid, Dislocation of.—From the strong plantar ligaments connected with this bone, and the powerful tendon grooving it, one might infer that dislocation would be a most exceptional injury. There is no recorded case of uncomplicated dislocation; but there are two specimens in the Musée Dupuytren of partial displacement downwards associated with dislocation of the astragalus.

Cuneiform Bones.—Dislocation of these bones is rare, and, when it does occur, is determined by their shape in an upward direction. The *internal cuneiform* is the most frequently dislocated in an upward and inward direction, a position due in part, no doubt, to the action of the tibialis anticus muscle. Astley Cooper records two cases, and Smith another, which were left unreduced. Nélaton, for a compound dislocation, removed the bone. All these patients recovered with useful feet. To effect reduction the great toe should be drawn forcibly outwards, and the bone then pressed into its place; but any difficulty in reduction or any tendency to reluxation should suggest to the surgeon the propriety of dividing the tibialis anticus tendon.

Scaphoid Bone of the Foot.—A simple dislocation *upwards* has been recorded by Walker. A bricklayer, jumping from one wall to another, alighted on his toes and fell forward. The scaphoid formed a prominence on the dorsum, and a depression existed where its tuberosity should, normally, have projected. By drawing the foot forcibly downwards and pressing with his thumbs, the surgeon reduced the bone with a click. Bryant mentions a similar case from Birkett's practice, which was also reduced; and Smith an unreduced case which he saw some years after the accident. Piédagnel has recorded a compound dislocation *downwards*, complicated with fracture, for which amputation of the foot was performed.

Scaphoid and Astragalus. — These bones are occasionally dislocated together upwards and outwards. Burnett has related a case caused by a gentleman, when hunting, taking a fence with his foot pressed strongly against the outer edge of the stirrup. The dislocation was compound, and the bones were reduced by pressure. B. Anger has recorded a somewhat similar case. For dislocations of the astragalus *see* Astragalus, Dislocations of the.

Smith's Dislocation of the Foot.—R. W. Smith first described a dislocation of all the metatarsal bones, together with the internal cuneiform, and explained the adhesion of this tarsal bone to its metatarsal as due to the tibialis anticus and peroneus longus tendons being partly attached on either side of the articulation. The foot was shortened an inch; a ridge due to the displaced bones occupied the dorsum of the foot; the plantar surface of the foot was convex transversely and from before backwards, and looked inwards. Dissection showed the bones to be displaced upwards and backwards. Smith describes two unreduced cases of long standing; Dupuytren one which he reduced; and Bryant two cases, one of which was displaced inwards.

The writer proposes to term this peculiar displacement *Robert Smith's dislocation*, in remembrance of that distinguished Dublin surgeon.

Tarso-Metatarsal Dislocations.—The metatarsal bones may be dislocated together *upwards, downwards, inwards*, or *outwards*. They may be also dislocated singly, or in groups of two, three, or four; and, rarely, some may be dislocated in one direction, whilst others are dislocated in another

These injuries are caused by falls from a height on the toes (the way in which Smith's dislocation is usually caused), or more frequently by crushing accidents. Many have been for a time overlooked, on account of swelling. The shortening of the foot in front of the ankle and loss of the arch, prominence of the bones, and deflection of the toes, are the principal signs of dislocation of all the bones. In single dislocation the projecting bone is generally evident, and the toe is shortened. In many cases extension has failed to produce reduction, but useful feet have remained. Hitzig has analysed 29 cases; 13 were of single bones, and 16 of the entire metatarsus; 11 of the latter were displaced upwards.

Toes, Dislocations of.—Metatarso-phalangeal dislocations are the most frequent; but inter-phalangeal displacements occasionally take place. Malgaigne records three instances of dislocation of all the toes—two upwards, and one compound and outwards. The latter necessitated excision of the end of the first metatarsal bone before reduction could be effected. The same author has collected 19 cases of dislocation of the great toe, all of which occurred in males. It may take place upwards and backwards, upwards and inwards, or upwards and outwards. The first form is the most common, and is often as difficult to reduce as dislocation of the thumb, for similar reasons. The treatment is the same as for metacarpo-phalangeal dislocation of the thumb.

Subastragaloid Dislocation of the Foot.—A displacement which leaves the astragalus in its normal relation to the tibia and fibula, but carries away all the other bones of the foot in a definite direction, is a not infrequent accident. Much confusion has existed concerning these subastragaloid dislocations, which, till somewhat recently, were altogether overlooked and confounded with dislocations proper of the astragalus, luxations of the os calcis, and midtarsal dislocations. The head of the astragalus is not firmly bound to the scaphoid, there being no inferior ligament uniting them, and but a comparatively weak superior one; hence, except for the support of other bones, this joint offers little resistance to dislocation. With the os calcis the astragalus is united by a strong interosseous ligament; but above there is a kind of mortise-like locking between it and the tibia and fibula, which, it is not difficult to understand, might often bear the strain of injury better than its ligamentous connections with the calcaneum. In this accident the foot separates from the astragalus at the calcaneo-astragaloid and astragalo-scaphoid joints.

Subastragaloid dislocation of the foot may take place in four directions—*inwards*, *outwards*, *backwards*, and *forwards*, of which the first-named is the most common. These dislocations are very rarely complete —that is to say, the articulating facets of the os calcis are not entirely removed from contact with those of the astragalus.

Subastragaloid dislocations may be distinguished from enucleations of the astragalus by the head of the bone being felt at its normal distance from the tibia and malleoli; by the fact that none of its upper articular surface is to be detected projecting beneath the skin; and by the existence of movements of flexion and extension at the ankle-joint. From dislocations of the calcaneum they are to be diagnosed by observing that the whole foot is turned in the same direction as that bone, and that the head of the astragalus has escaped from its socket. Dislocations of the ankle-joint are unaccompanied by the prominence caused by the displaced head of the astragalus, and the movements of the joint are lost.

R. Clement Lucas.

FOOT, Fractures of Bones of the.—Astragalus.—Though not very rarely dislocated, the astragalus is but seldom fractured; some clear examples, however, of this injury have been recorded. Doubtless fracture is sometimes present, though it is masked by the enclosed situation of the bone, or by injury of the surrounding parts. It is usually caused by falls from a height on the feet, and may involve any part of the bone—its neck, general mass, or posterior portion. It is often accompanied by dislocation. The writer lately met with a case in which, together with a partial dislocation, so that the bone was rotated on its antero-posterior axis in such a way that its inferior surface presented directly inwards, there existed a fracture of its internal border. This injury may be combined with fracture of the malleoli.

Symptoms.—Pain on pressure, or on any attempt to bear weight on the foot, the presence of crepitus on movement, combined with an absence of injury to other parts, and diminished height of the malleoli from the ground, would be the most marked signs of this injury. Sometimes the detached fragment has been found protruding under the skin. But when other tarsal bones are injured, and when swelling is considerable, an exact diagnosis cannot be made.

The only *treatment* generally required is to subdue inflammation by position, rest, and cold applications, and subsequently to maintain rest by a well-adjusted splint, or a light case of plaster of Paris. If any portion of the bone is protruded and cannot be replaced, it may be necessary to remove it. This operation should be performed with very careful antiseptic precautions. It is best, however, to postpone interference till the swelling and inflammation following the accident have subsided. As some stiffness is very likely to remain, a guarded prognosis should be given; and the foot should be placed at a right angle with the leg, so that the heel, when the patient is allowed to walk, may be easily brought to the ground.

Calcaneum.—This bone may be fractured either by direct violence, as the passage of a wheel over, or the fall of a heavy weight upon, the foot, by a fall on the feet, or by muscular action. The fracture may take any direction, or involve any part of the bone. When due to direct violence it is often extensively comminuted, and accompanied by great injury to the soft parts of the foot. Sometimes, though rarely, it is compound. When the result of muscular action, it involves the part of the bone lying behind the astragalus, and the fragment, variable in size, is drawn upwards—sometimes slightly, but sometimes to the extent of two, three, or even five inches, by the muscles of the calf. In fracture of other parts of the bone displacement is usually very slight, the fragments being held together by their connection with the surrounding fibrous structures of the foot. Cases in which both calcanea were fractured have been recorded.

The *symptoms* consist of pain, swelling, extravasation of blood, and crepitus, produced by grasping the heel and moving the anterior part of the foot upon it; by fixing the heel and flexing the anterior part of the foot; or by grasping the heel while the patient moves his toes. In cases of extensive comminution there is marked increase in the width of the bone below the malleoli, and flattening of the arch of the foot. When the bone has been severely crushed, especially if the fracture has involved the sustentaculum tali, so that the tendons have been displaced, the strength and movements of the foot are considerably diminished, and there may be a troublesome tendency to valgus. Generally, however, in fracture uncomplicated with much displacement, satisfactory recovery takes place, although repair is very tedious.

Treatment, when displacement is slight, consists in reducing inflammation by position and cold applications, and the subsequent employment of a plaster of Paris or leather splint; and allowing the patient to be about on crutches for two months or more before any weight is thrown upon the foot. At a later period much may be done by careful passive movements, after any adhesions that may be present have been broken down. When the fragment is displaced by the muscles of the calf, the leg must be flexed upon the thigh and the foot extended on the leg, as in rupture of the tendo-Achillis, and retained in that position either by a loop passing from the heel of the slipper and fastened above the knee, or by the apparatus recommended in rupture of the Achilles tendon.

Tarsus and Metatarsus.—Fractures of the remaining parts of the tarsus, and of the metatarsus call for no detailed notice. They are always the result of direct violence, and are frequently compound, and attended with considerable laceration of the soft parts. When the fracture is simple, all that is required after adjustment has been effected is a splint to control the fragments and keep them at rest. For this purpose plaster of Paris is often useful. When the soft structures are lacerated, or when the bones are comminuted, care should be taken to remove parts as sparingly as possible. Yet it must be remembered that when the foot has been crushed the soft parts are often more widely injured than is at first sight apparent, and extensive sloughing of the flaps will sometimes take place.

Howard Marsh.

FOOT and ANKLE, Diagnosis of Injuries and Diseases of.—In diagnosing an injury about the foot and ankle the surgeon must remember—(I) certain bony landmarks; (II) what are the common injuries; (III) the chief points which will help in diagnosis.

I. Bony Landmarks.—*Malleoli.*—The outer descends lower than the inner, and locks the joint in more completely, a point which makes opening the joint in Syme's amputation more easy on the inner side. The tip of the outer is about half an inch below and behind that of the inner malleolus. Their posterior borders are in the same plane, owing to the greater antero-posterior diameter of the internal.

Foot.—Inner side.—(1) Internal tuberosity of os calcis. (2) Tip of internal malleolus. (3) Sustentaculum tali, one full inch below internal malleolus. (4) Tubercle of scaphoid, one full inch below internal malleolus and a little lower down, the gap between (3) and (4) being filled by the calcaneo-scaphoid ligament. (5) Tuberosity of the internal cuneiform bone. (6) Base of first metatarsal bone. (7) Head of metatarsal bone and sesamoid bones.

Outer side.—(1) Outer tuberosity of os calcis. (2) External malleolus. (3) Nearly one inch below the malleolus, and a little in front of it the peroneal tubercle, with the short tendon above and the long below. (4) Base of fifth metatarsal bone.

II. Injuries Common in this Region. These may, for practical purposes, be divided into two groups.

A. *Those without fracture or dislocation.*—(1) Sprains. (2) Rupture of tendo Achillis. (3) Slipping of tendons.

1. *Sprains.*—Sprains of the ankle are fully described under that heading; it remains only to point out the chief points which distinguish them from fracture or dislocation. Amongst these are the absence of crepitus or bony deformity, the comparatively slight injury, such as a slip or twist on uneven ground, the fact that the patient has very likely been able to use the foot between the time of the accident and the visit of the medical man, the correspondence of measurements between bony points in the two limbs.

2. *Rupture of the tendo Achillis.*—It may be diagnosed by the comparatively trivial violence, as the mere strain of walking, dancing, &c., the feeling of a snap or as if a blow had been struck on the part, the depression between the ruptured ends, increased by action of the muscles, &c. Much more rarely the rupture of a tendon near the ankle takes place in the case of the peronei or tibialis posticus.

3. *Slipping of Tendons.*—This usually takes place with the peronei, which most frequently of all tendons in the body get out of their grooves. The condition may be diagnosed by the history of a twist or slip, followed immediately by pain, swelling, and ecchymosis along the sheath, and the feeling of the tendon as it slips backwards and forwards over the posterior edge of the external malleolus.

B. *Injuries accompanied with Fracture or Dislocation.* — Those most frequently met with are—(1) Fracture of the lower ends of the fibula and tibia, with partial dislocation of the foot. (2) Dislocation of the astragalus. (3) Subastragaloid dislocation. (4) Dislocation at the ankle, which may take place laterally or antero-posteriorly, the dislocation outwards being most common, and all of these dislocations being very liable to be accompanied by fracture of one or other of the bones of the leg. (5) Fracture of astragalus. (6) Fracture of os calcis. (7) Injury to epiphyses, e.g. that of the tibia.

III. The following are the chief points to which paying attention will aid the practitioner in making out the nature of an injury about the ankle, accompanied with fracture or dislocation:—

1. *The kind and severity of the violence*—thus, a sudden exertion, as in lawn-tennis, dancing, running, &c., may produce rupture of the tendo Achillis, slipping of the peronei, or sprain of the ankle. A slip on uneven ground, down a bank, &c., may produce a sprain or one of the slighter forms of fracture of the malleoli, with displacement of the foot outwards or inwards, far more frequently the former. More violent twists, a direct blow upon the ankle, coming down with the foot sideways after leaping, the foot being caught and fixed while the body is free to move, jumping from a carriage in motion, and similar accidents, are much more likely to cause the severer forms of Pott's fracture, and dislocation of the astragalus, or subastragaloid dislocation of the foot.

2. *Comparison of the two ankles and feet.* If a depression is found one or two inches above the external malleolus, with prominence of the malleolus on the inner side, the practitioner will know that he is dealing with Pott's fracture. If, in addition to the above, there is widening between the malleoli, there is probably a split running through the lower extremity of the tibia into its inferior articular surface, as well as a fracture of the fibula. If the malleoli seem to have settled down on to the dorsum, and under the skin of this region is a projection lying obliquely inwards or outwards, resembling the anterior and rounded, or superior and trochlear surface of the astragalus, this bone has probably been dislocated. If the malleoli have not sunk down on to the dorsum, if some movement of the ankle-joint remain, and just in front of the tibia the head of the astragalus can be felt rounded and prominent, one malleolus projecting while the other is buried in a deep fossa, the foot being inverted or everted, and no crepitus obtainable, a subastragaloid dislocation of the foot laterally has probably taken place.

3. *Crepitus.*—This is often difficult of detection in fractures of this region, owing to the rapidity with which the natural fixity of the parts is increased by swelling,

the great pain, and by the fact that occasionally, as in Pott's fracture, reduction may have taken place. The following may aid in detecting crepitus:—Pressure with two fingers on either side of the suspected fracture, e.g. a malleolus; rotation of the foot from side to side; keeping one finger over the suspected site of fracture, and making pressure at a distance so as to 'spring' the bone of the fibula at the spot where this is broken.

In the absence of other symptoms of fracture—e.g. displacement—where, after severe injury, there is much pain, inability to use the foot, and deep-seated crepitus, fracture of the astragalus or os calcis may be present. Where in an apparent fracture of the end of the tibia, the crepitus is modified, when the patient is about sixteen or seventeen, and when the lower end of the upper fragment is smooth and rounded instead of sharp and rough or angular, the injury is separation of the lower epiphysis of the tibia.

4. *Measurements.*—These are of less value here than in fractures of the long bones, owing to the injury not being so localised, and the amount of swelling which so often obscures the bony landmarks. Finding, in examining a suspected case, injury to the ankle or foot, the practitioner will remember that the majority of patients will make no allowance for the difficulty and obscurity which often accompany the examination of these cases, or for the tedious and troublesome sequelæ which sometimes follow on most careful treatment, and, remembering this, he will do well to fortify himself with the advice and opinion of a friend or neighbour.

The most common forms of disease which present themselves for diagnosis in the foot are the various forms of synovitis and caries. Synovitis in its acutest form will be often met with in a sprain of the ankle. Forms much more insidious, and tending gradually, if untreated, to serious disorganisation, are met with in the ankle, the calcaneo-astragaloid, and the medio-tarsal joints. Stiffness and tenderness, preceded by some injury or over-use (both, perhaps, of little apparent moment), are followed by increasing swelling and actual pain. In the case of the ankle-joint the swelling will show itself chiefly in front and around the malleoli. In the case of the astragalo-calcanean joint the swelling is much less distinct, owing to the depth and surroundings of the joint. No certain diagnosis can be made without watching the case, allowing for its insidiousness, its crippling nature, and the exclusion of any evidence of disease of the ankle-joint. In synovitis of the medio-tarsal joints, which should always, if possible, be recognised early, owing to the extent of the synovial membrane and the number of bones with which it is in contact, it will be found, on comparing the two feet, that the natural instep is lost, being gradually replaced by a swelling which gradually becomes more and more clubbed.

Where pulpy disease and caries have followed on synovitis, their presence will be known by the preceding history, the longer duration, the formation of abscesses here and there, owing to the implication of the skin and soft parts, leading to sinuses, with their characteristic bluish, undermined edges and prominent granulations. The chief seats of caries are the os calcis, the ankle-joint, and astragalus (for these may practically be taken together, the latter being only occasionally by itself the site of disease), the medio-tarsal joint, occasionally only the cuboid, and, more often, the metatarsal bones, these being, especially in 'strumous' children, liable to be the sites of multiple caries. From the devious burrowing of pus, sinuses over a bone do not necessarily mean caries of that bone, but must be taken with other points, such as the site of the chief thickening; whether behind and below the malleoli and obliterating the natural hollows there, as in caries of the os calcis, or in front of the malleoli and even a little up the leg over the ankle-joint, combined with impaired movement of the joint, when that is involved, and so in other cases. Sinuses on the plantar aspect of the foot almost always point to that form of caries which is associated with, or secondary to, Perforating Ulcer.

W. H. A. Jacobson.

FOREARM, Amputation of the.—Amputation of the forearm may be performed at either its lower, middle, or upper third. Owing to early prejudice against the operation in the lower third on the part of some eminent French operators—notably Larrey—on account of the large number of tendons, the middle and upper thirds were the situations preferred. The opinion generally accepted now, however, is that unless there be some special contra-indication, the lower third is the most desirable situation. The particular operation to be selected depends largely on the situation in which it is to be performed. The circular or rectangular methods are best in the lower third; in the middle of the forearm, the antero-posterior flap method or the rectangular amputation; and in the upper third, Syme's modified circular, or the antero-posterior flap method. When practicable, amputations of the forearm, whatever method be adopted, should, as maintained by Skey, be performed below the supinator brevis and pronator radii teres, with a view to the preservation of pronation and supination of the limb.

The *circular* operation may be performed as follows:—Pressure on the brachial artery should be made either by digital pressure, by an Esmarch bandage, or a Petit's or Signoroni's tourniquet. The elastic Esmarch bandage is, in the writer's opinion, to be preferred. Supposing the right forearm to be the one to be operated on, the surgeon, standing on that side of the patient, grasps the forearm with his left hand and retracts the skin, the portion of the limb to be removed being held steadily and somewhat elevated by an assistant. A circular incision is then made with a medium-sized amputation knife down to the fascia, and the skin dissected back for the distance of an inch or an inch and a half. The second stage of the operation consists in the division of the muscular tissues at the upper angle of the wound down to the bones. There the interosseous membrane and periosteum round each of the bones are carefully divided, and the bones are then simultaneously sawn across. The radial, ulnar, and interosseous arteries should then be secured, and the wound dressed. This method may also be employed in the upper third of the forearm, but is not so applicable to the centre or middle third of the forearm, where the flap operation is, as a rule, performed.

In this situation the antero-posterior *flap* method, for the reasons already stated, is the operation usually indicated. It may be carried out by long anterior and short posterior flaps, or by antero-posterior flaps of equal length. They may be made either by transfixion, or, if the arm be large and muscular, by cutting from without. Short musculo-cutaneous flaps, with oblique division of the deeper structures, are recommended by Sédillot (Alanson's operation somewhat modified). The simplest and best method, when the middle third of the forearm is the situation to be operated on, is that by antero-posterior flaps made by transfixion. The limb should be held in the prone position by an assistant. The operator then, grasping the dorsal tissues with his left hand, draws them up, determining accurately at the same time the edges of the ulna and radius. With a medium-sized catlin the dorsal tissues are transfixed, care being taken not to fall into the error, occasionally made by unskilful operators, of getting *between* the bones. A flap two or three inches in length is then made, and in doing so the operator should avoid having an irregular, jagged edge to it. This he can best do by avoiding too short and sawing an action of the knife in the division of the tissues. The flap having been made, it is held back by an assistant, and the catlin is then reintroduced in front of the bones, and a flap somewhat longer than the posterior one is made, ending somewhat differently, for the tissues should not be divided so obliquely as in the posterior flap, but cut more abruptly or squarely. The interosseous structures should then be divided, the periosteum carefully incised at the points where the bones are to be sawn, and the latter then simultaneously divided. The radial, ulnar, and interosseous vessels will require ligature, the first two of which will be found in the anterior flap, the radial being most superficial.

Teale's rectangular flap method is, in cases where the tissues are abundant, applicable to amputations of the lower and middle thirds of the forearm. In the upper third, where the bones occupy a more central position, and the muscles are thick, lateral flaps have also been recommended. The writer, however, fails to recognise any advantage to be obtained by substituting this latter method for either the modified circular or the antero-posterior flap operations.

In performing Teale's rectangular amputation, the radial vessels should be in the short flap. 'The operator,' Mr. Teale observes, 'in forming the long flap, makes the two longitudinal incisions merely through the integuments, but the transverse one is carried directly down to the bones. In dissecting the long flap from below upwards, the tissues of which it is composed must be separated close to the periosteum and interosseous membrane. The short flap is made by a transverse incision through all the structures down to the bones, care being taken to separate the parts upwards close to the periosteum and membrane. The prone position is recommended, to allow the dorsal flap to be superior when the patient is recumbent, and thus fall over the ends of the bones.'

In reference to the statistics of amputations of the forearm when performed on account of serious injuries, it is interesting to note a fact recorded by Dr. Otis, and mentioned by Agnew in reference to the superiority of primary over intermediary and secondary amputations, the mortality of primary being 9·6 per cent., intermediary 23·5 per cent., and secondary 15·7 per cent. The special points to be borne in mind in amputation of the forearm, are:—

I. Division, when possible, of the bones below the insertion of the pronator radii teres and supinator brevis.

II. Selection in the lower third of the circular or rectangular operations, and in the middle and upper thirds of the antero-posterior flap method.

III. In the latter group of amputations the division of the bones at least half an inch above the angles of incision of the soft parts, in order to prevent projection of them at the sides of the wound.

William Stokes.

FOREARM, Diagnosis of Injuries and Diseases of the. *See* Arm and Forearm.

FOREIGN BODIES IN THE AIR-PASSAGES.—Foreign matter of the most diverse kind, gaseous, liquid, or solid, not infrequently enters the air-passages, and gives rise to symptoms, varying in severity and urgency according to the nature, size, shape, and position of the offending substance.

Irritating vapours or minute solid particles suspended in the air, as they touch the upper part of the larynx generally excite such a violent fit of coughing that they are swept away at once, and, beyond the immediate distress and discomfort, give rise to no further consequences. Only exceptionally, when, as in the case of steam from a tea-kettle, they are drawn well in by a sudden inspiration, and inflict serious injury on the mucous membrane, does inflammation follow and affect the larynx, or the trachea and bronchi, or even the lungs themselves. So also with liquids; only, from the peculiar circumstances under which they enter, the consequences are more lasting and more serious. It is rare for them to penetrate further than the larynx, from which they are ejected at once, unless it has undergone some change which has either impaired its sensibility or rendered it less capable of rapid and co-ordinate action. For example, after wounds involving the floor of the mouth or the air-passages (such as cut-throat), and also after tracheotomy, the larynx sometimes loses its delicate sensitiveness, probably from swelling and œdema of the mucous membrane, and does not close with sufficient rapidity to prevent liquid portions of food passing down the trachea into the lungs. Pneumonia set up by this is the cause of the fatal issue in many cases of tracheotomy which have survived both the primary mischief and the immediate effects of the operation. The same thing may happen as a consequence of diphtheritic paralysis, or when a patient is insensible, either from anæsthetics or from alcohol. During operations about the mouth, blood and fluids from the stomach vomited up may be drawn down the trachea, and, according to the amount, either cause an immediately fatal asphyxia or broncho-pneumonia some days later.

Solid substances may enter under similar conditions; sets of false teeth (which ought always to be removed prior to the administration of an anæsthetic), a tooth dropped from the forceps immediately after extraction in the haste to grasp a second, wedges to keep the mouth open, improperly secured, are all recorded as having dropped into the larynx. The same thing has been known to occur during sleep, or in the vomiting following anæsthesia. A case of death after the administration of ether was found to be due to the skin of a ripe plum, rolled up; it had been vomited during the stage of recovery, drawn into the larynx, and was firmly wedged into the right bronchus, so that its upper extremity fell over and occluded the orifice of the left. In the vast majority of instances, however, this very serious accident arises from a careless habit of holding things in the mouth or between the teeth, especially in the case of children. Something or other, such as a laugh or a blow on the back, causes a sudden inspiration, and the substance, whatever it may be, is drawn down through the widely open glottis and lodged in the air-passages before it is known that the hold on it is lost. Blow-tubes carrying a dart, pea-shooters, and other hollow instruments, act in the same way. A child, in trying to fill its chest with air previously to a vigorous expiratory effort, often inspires with all its force through the tube, and draws the projectile into the larynx.

It is rare for solid bodies to enter in any other fashion, but exceptional cases are on record in which they have penetrated through wounds, or, more often, through openings produced by ulceration, especially of a malignant character, where the trachea or the left bronchus lies in contact with the wall of the œsophagus.

Cases of epithelioma of the œsophagus are not infrequently brought to an unexpectedly rapid termination by an attack of pneumonia set up in this way.

The symptoms that follow the entry of a foreign body are either immediate and due to obstruction, whether this is caused by the substance itself or the spasm it excites; or else remote and secondary, set up by the inflammation that follows; and they depend mainly on two conditions—the position of the body, as determined by its size, weight, and shape, and the changes which it undergoes itself or induces in the tissues with which it is in contact. For convenience of description the air-passages may be divided off roughly into three portions—that lying above the rima glottidis, including the upper aperture and the ventricles of the larynx; the lower part of the larynx and the trachea, including its bifurcation; and, lastly, the bronchi of the second order and the lungs. Of course this division is artificial, and it does not by any means follow that when a foreign body is fixed in one part the symptoms will be confined to that part; but there is sufficient difference both in the consequences and in the treatment to justify its adoption.

When lodged in the *larynx*, the symptoms caused by a foreign body are most severe and very characteristic. From the spasm, distress, and violent cough produced when anything touches the interior of the larynx, it is easy to infer the course of events when either a large rounded mass blocks the opening by its size, or a smaller but sharp and angular one is impacted in the mucous membrane and sets up spasmodic contraction. The patient starts up wildly, gasping for breath, and clutching at his collar; the face is livid, rapidly becoming cyanosed; the veins in the neck and in the forehead stand out like cords; he may be quite unable to speak, or, more often, if the orifice is not quite closed, utters the most distressing inarticulate cries, attempting at the same time to put his finger down his throat; violent coughing, often leading to vomiting, is rarely absent; the body becomes more and more convulsed, a cold sweat breaks out all over, commencing on the face, and within a minute he may fall down unconscious, fæces and urine escaping without control.

The symptoms, however, are not always so urgent as this; after some time—it may be a few minutes or it may be some hours—they gradually diminish in intensity, leaving the patient in a state of complete exhaustion. But they are liable to return with all their former severity at any moment, and this tendency to recurrence with intervals of almost complete repose is one of the most important points in the question of diagnosis. Their degree of severity depends mainly on the size and shape of the body and its exact position; if it is smooth and rounded, of some material that does not swell up or undergo other change, and lodged in one of the ventricles, they may be exceedingly slight, or be postponed for an almost indefinite period, although the patient is never free from the danger of asphyxia, due to dislodgment and impaction elsewhere, or from the risk of inflammation and ulceration. Pain, or a sensation of tickling in the region of the larynx, often felt in the ear, and a sense of anxiety or of impending suffocation, are nearly always present; so are frequent and violent fits of coughing, characteristic from the sudden way in which they come on, their sharp, spasmodic character, and uncontrollable violence; a change of posture is often sufficient to induce them. At first they are unattended by expectoration, but afterwards, when inflammation has set in, this may be copious, thick, and stained with blood. The respiration, especially in children, is often distinctly croupy, so as sometimes to render the diagnosis difficult; but it is to be noted, conversely to what happens in croup, that expiration is generally more difficult than inspiration. The voice may be quite lost, or may at first be hardly altered in its tone, according to the position of the foreign body; but nearly always it becomes changed and hoarse after the first few hours, from swelling and œdema of the mucous membrane.

If the foreign body is allowed to remain, the symptoms that arise vary greatly in different cases. When it is sharp and pointed, or of such nature as to be a continual source of irritation to the structures among which it is lying, inflammation sets in rapidly; and although confined at first to the larynx and the immediate neighbourhood of the offending substance, soon spreads thence to adjacent parts, and finally to the trachea and lungs. Ulceration of the mucous membrane, involving the cartilages at last, and causing necrosis and destruction of the articulations; spasm and œdema of the glottis, with constant danger to life at any moment; emphysema of the lungs; congestion, followed by bronchitis and broncho-pneumonia; rupture of blood-vessels from the violence of the cough may ensue. Great impairment of the general health, ending in fatal exhaustion, from the combined effect of inflammation, continued anxiety, and want of rest, will follow inevitably sooner or later, sometimes commencing within a few days, or, in exceptional instances, not sufficiently severe to attract serious attention till years have elapsed and the exciting cause has almost been forgotten.

In those cases in which the foreign body slips between the vocal cords and enters the *trachea*, but is too large to be admitted into the bronchi of the second order, the immediate symptoms are, as a rule, of less intensity, the secondary ones more severe. They seem to depend mainly on whether it is fixed in the mucous membrane of the trachea or remains free in the interior, so that it can move up and down, and depend consequently more upon the shape and weight of the substance than anything else. A smooth, round, heavy body, such as a coin, falls down to the bifurcation, and, owing to the position of the septum, is generally directed to the right side, where it either becomes impacted in the bronchus or remains free, and with every cough shifts its position. This makes the diagnosis more easy, for in addition to the distress, dyspnœa, and pain that are always present after the entry of a foreign body, every time it comes in contact with the larynx or moves in the trachea it excites such violent paroxysms of coughing, often preceded by a deep whooping inspiration, as are seldom met with under other conditions, especially as aphonia under these circumstances is not a common symptom. Sometimes the patient is himself conscious that the body shifts its position; or it may be heard, and even has been felt from the outside, moving about in the trachea. It occasionally happens that during one of these attacks the foreign substance escapes through the orifice of the glottis with instant relief; but it must not be forgotten that it may be caught and held in the same situation, and give rise to a spasm that will prove rapidly fatal.

If the shape is more irregular, particularly if it is pointed at one end like a bearded ear of corn or a puff-dart, both of which are more than usually dangerous from the way in which they lie with their points uppermost so that each cough drives them further and further in, it generally becomes fixed, and soon excites inflammation, attended by copious expectoration and ulceration. The rapidity with which this sets in depends on the irritating nature of the body and on the changes it undergoes. Some organic substances, particularly when they are retained in a bronchus in contact with the mucous membrane all round, and exposed to a moist and even temperature, swell up to double their former size, and, in the case of seeds, have even been known to show signs of germination. Others remain unchanged themselves and become less irritating, though their size is increased from the deposition of layers of mucus on their surface. When fixed in this way the pain is felt most acutely over the actual spot, although a sensation of soreness behind the sternal notch is rarely absent. Aphonia is not met with, at any rate at first, and the fits of coughing, being due rather to the irritation and inflammation, are less violent and spasmodic, but more continuous, than when the foreign body is always shifting its position and coming in contact with the larynx.

The same train of symptoms is apparent when the foreign body is small enough to pass beyond the bifurcation of the trachea and enter the *bronchi* or the substance of the lung, only now those caused by the obstruction are less marked in proportion to the smaller area shut off, and those due to the consecutive inflammation become more prominent. Important evidence in addition may be obtained from an examination of the chest. If one of the bronchi, and it is usually the right one, is partially obstructed, that side of the chest moves less in inspiration, the percussion note is unaltered at first, and the respiratory murmur is diminished; while occasionally an unusual whistling sound may be heard, owing to the passage of the air past the obstruction, and nearly always coarse râles, due to the greatly increased secretion thrown out by the irritated mucous membrane. On the other hand, should the whole of one lung or of one lobe be shut off, vocal fremitus and the normal vesicular murmur are completely absent over the corresponding area, and the respiration over the rest is puerile and exaggerated. The percussion note varies; at first it is normal, or may even be hyper-resonant for a time, but in a few hours, as the lung becomes congested and the air absorbed, this diminishes to such an extent that it may be almost dull.

The later symptoms, consequent on lodgment in the lungs, depend on the intensity and progress of the inflammation that follows. It may be slight, and even postponed for years; more often it is rapid and acute, broncho-pneumonia setting in with great severity and running on to the formation of abscesses, with destruction of the lung, and even gangrene or fatal hæmoptysis, this depending in all probability on the ease with which the intruding substance undergoes septic changes. Pulmonary tubercle, hyperæmia and swelling of the bronchial glands, ending in caseation and suppuration, and occasionally empyema, with even the escape of the foreign body through the walls of the thorax, have also been described as resulting from this injury, though they are much more rare.

Numerous instances are on record in which the accident has been overlooked and the symptoms assigned to some other cause, and nearly as many in which the opposite mistake has been made. Nor is this surprising when we take into consideration the fact that there is no single symptom peculiar to it alone, and that the history, which is of the utmost importance, is often altogether wanting, because the patient was either insensible at the time or too young to be able to give an account of himself. Foreign bodies in the pharynx, by pressing on the back of the larynx, or by the spasmodic contraction they set up, may cause immediate death with all the symptoms of obstruction to the larynx; but this is not of so much importance, as the same treatment would apply to either if it could only be carried out in time. When the symptoms are less urgent the diagnosis is easily made by making the patient swallow, or, if necessary, by examination with the finger or an œsophageal probang.

Inflammatory affections of the air-passages set up by other causes are much more hard to diagnose. Croup, especially in children, and laryngitis setting in suddenly, may be very difficult to distinguish in the absence of any history. Most reliance is to be placed on the sudden character of the onset, and the absence, at the commencement, of feverish symptoms as judged by the state of the pulse and the skin. It is very rare for either croup or laryngitis to commence with such rapidity or attain such severity in the first few moments, and the remissions that occur in the course of these diseases are not nearly so complete. Moreover, in spasmodic croup, the chief difficulty is during inspiration—the reverse of what obtains when a foreign body is lodged anywhere in the respiratory tract.

Hysteria, reflex irritation arising from disorders of the alimentary canal, especially in children, spasm of the glottis consequent on ulceration of the larynx or trachea, œdema due to the same cause, even such affections as aneurism of the aorta, pressing on the laryngeal nerves, and whooping cough, may occasionally present such symptoms as to make the diagnosis doubtful at first, particularly if the history is misleading—if, for example, the patient was known to be holding something in his mouth when the attack first commenced and the substance cannot be accounted for. Sometimes, too, the feeling of irritation left after the foreign body has been removed is so distinct that the patient firmly believes it to be still there; and it must not be forgotten in connection with this that on several occasions more than one foreign body has been known to enter the larynx at the same time, and that it is quite possible for some of the substances which find their way in to break into separate pieces during a violent attack of coughing.

Treatment.—Unless the case is so urgent that the larynx must be opened on the spot, it is most important to obtain as accurate an account as possible, not only of the previous condition of the patient, and of the fact that he was holding in his mouth or playing with some substance which cannot be found, but also of the nature, size, and shape of that substance, so that some idea may be formed of the situation in which it will lodge and of the changes it will undergo. Then, if the symptoms permit, a thorough and careful examination of the mouth, epiglottis, and upper part of the larynx, must be made with the finger and the laryngoscope, an anæsthetic being administered if it is required. If nothing can be ascertained by this, if the acute symptoms have passed off, and only recur at intervals with less intensity; and particularly if there is no aphonia or pain in the region of the larynx or ear, it is probable that the substance has passed through the rima glottidis and is lodged in the trachea or bronchi, where its presence may be ascertained by careful inspection, auscultation, and percussion. Very severe symptoms at the first, subsiding without extrusion, point to the substance having passed the larynx and entered into the trachea; their repeated recurrences suggest its still being present in the larynx, or loose in the trachea and coughed up against it.

'It may be definitely and decidedly asserted that life is in peril so long as a foreign body of any appreciable size is retained in the respiratory tract. At the same time it is very uncertain at what period danger may become imminent, and in what way it may arise' (Durham). Suffocation, laryngitis, hæmorrhage from ulceration, inflammation and œdema, pneumonia, pleurisy, phthisis, or gangrene, may make their appearance at any time so long as the foreign body is retained; and even after it has been expelled the morbid process originated by it may still go on to a fatal issue. The first thing, if time permit, is to make as sure as circumstances allow that a foreign body is really there; and then, unless the symptoms are very urgent, to endeavour to ascertain in what part it may be lodged. Sometimes laryngotomy must be performed without an instant's delay if it is to be of any service. The operation is easy, the crico-thyroid membrane superficial, the extra risk to the patient quite trivial, and the danger of hæmorrhage slight; while the relief is perfect in proportion to the severity of the symptoms, and valuable time is gained for more deliberate action.

When the case is not so urgent, when, as is usually the case, the patient is seen after the first violent paroxysm has passed off, during the deceptive calm that follows, an attempt must be made to ascertain the exact position of the substance; but under no circumstances should the patient be left without assistance. Many cases, especially in childhood, have suddenly proved fatal from œdema, spasm or impaction, owing to the deceptive calm that so often follows the first outbreak.

By means of the laryngoscope and laryngeal forceps of various shapes a large number of foreign bodies of all kinds have been extracted from the larynx. Even in children this method succeeds sometimes, while with adults the results are very encouraging, pins, bones, rings and other substances having been removed even after long periods of impaction, without external wound or any after-trouble. The extreme sensibility of the mucous membrane in many patients, rendering even examination difficult, and any operation impossible, may in general be overcome by the prolonged application of ice or the inhalation of chloroform vapour. Small subcutaneous injections of morphia over the superior laryngeal nerve in the region of the greater cornu of the hyoid bone are sometimes very successful as a temporary measure; and provided the time can be afforded, large doses of bromide of potassium for several days help materially; but the most useful application of all for this purpose is a 20 per cent. solution of hydrochlorate of cocaine. If the fauces and the upper aperture of the larynx are painted with this three times at five minutes' interval, the mucous membrane becomes quite insensitive without the least danger or inconvenience, and remains so for a quarter of an hour, so that operations may easily be performed while the patient is free from pain, quite quiet, sensible, and able to assist.

Should the laryngeal forceps fail, owing to the situation of the foreign body preventing firm hold being obtained or from any other cause, the choice of the surgeon lies between laryngotomy and exploration of the interior of the larynx from below with a probe or gum-elastic catheter (using the end covered with an ivory cap and taking care that it is well secured), or thyrotomy—i.e. a vertical section in the middle line between the two alæ of the thyroid cartilage, so that when they are separated the whole cavity is exposed to view. The latter is the better of the two unless laryngotomy has already been performed to relieve symptoms of obstruction. The whole interior of the larynx, including the ventricles, can be thoroughly explored by this operation, and if care be taken to keep the section exactly in the middle line, and to unite the perichondrium or the fibrous layer covering the cartilages accurately by catgut sutures, union takes place readily and the voice rarely suffers.

Supposing it has been ascertained that the foreign body is not in the larynx, and the symptoms point to its being in the trachea or bronchi, tracheotomy, or if the neck is very short laryngo-tracheotomy, should be performed without more delay than the time to administer an anæsthetic. Emetics, sternutatories, inversion, and other so-called remedies only waste time and distress the patient. It is true they have all of them occasionally been successful, but the same thing might be said with equal truth of the plan of leaving the patient alone. The only possible exception is in the case of small, round, and heavy bodies loose in the trachea without urgent symptoms; but even then inversion should never be attempted without all preparations being made for instant tracheotomy, and it is as well to avoid having to perform this operation against time.

It often happens that the foreign body is ejected either through the glottis or the tracheal opening, immediately after this has been made, a large volume of air being taken in, the spasm completely relaxed, and violent coughing excited. When this does not occur, and very often it is some time before the intruding substance is dislodged, the patient is almost safe from the danger of asphyxia, and valuable time has been gained for other measures. No canula should be inserted unless extraction fails; retractors, easily made with a piece of bent wire, should be fixed in the tracheal opening and fastened round the neck with an elastic band, so as to maintain a certain amount of tension on the orifice. The patient may then be turned over on to his abdomen with the edges of the wound held as wide apart as they may be, gradually inverted and sharply struck across the back opposite the spines of the scapulæ. Or the body may be secured on a narrow table in the supine position, which has the advantage of presenting the widest part of the glottis to the foreign body when it comes in contact with it, quickly inverted, and compressed with a broad circular bandage, so as to secure vigorous expiration in that position.

If this procedure fails and the foreign substance is too firmly fixed to move, the trachea, and bronchi, as far as they can, must be very gently explored with probes, hooked at the end, tracheal forceps (either Gross's, which are made of German silver so that they can be bent to any shape, or Mackenzie's, or Durham's, which are so contrived as to open only at the extremities), and even with the finger. All these attempts bring on violent expiratory efforts, no matter how gently they may be performed, and sometimes in this way, sometimes by being actually hooked up, large firmly-wedged bodies have been extracted, even from the right bronchus. A great deal depends on a knowledge of the nature of the substance : tubular bodies, such as a broken-off tracheotomy canula, from their allowing one blade of the forceps to enter the interior and grasp the margin, or both blades to pass inside and raise it by the pressure they bring to bear when opened, are particularly easy of extraction. The worst of all are such things as puff-darts, which lie with the point uppermost and fixed in the mucous membrane, so that every effort of expiration only serves to drive it further in; if this can be felt to have perforated the trachea it should be cut down upon and removed with pliers.

It by no means always follows that the operation of tracheotomy is successful at once : there are many instances in which a canula has been inserted and worn for some time, and then quite unexpectedly, perhaps from changes it undergoes itself, or from ulceration round it, the foreign body has suddenly become detached and been expelled.

The main object in the after-treatment is to check any tendency to inflammation. The patient must be confined to his room, and even to bed, for the first few days; the air must be kept of even temperature, and sufficiently warm and moist, by means of steam; there is no need to retain the canula after extraction unless œdema of the larynx is feared; the wound need not be closed by sutures, but covered over with a layer of moistened gauze to prevent the entry of cold or dusty air, and allowed to granulate; the edges will generally be found in apposition and the tracheal opening almost closed, from the elasticity of the cartilages, in twenty-four hours. The diet should be mild and unstimulating; morphia may be given (provided there is no severe bronchitis) to relieve the feeling of irritation, and expectorants if there is much secretion. If the foreign body has been impacted for any length of time there is nearly always some thickening and induration of the mucous membrane resulting from ulceration, but this usually subsides of itself after removal; the exuberant granulations that are sometimes found blocking up the passage must be removed by scissors or caustic.

In the later stages Gross considers an operation not only to be justifiable but highly proper so long as the respiratory passages are healthy or even comparatively healthy, no matter what length of time may have elapsed since the entrance of the extraneous substance. 'If, on the other hand, the respiratory apparatus is seriously diseased, the knife should be studiously withheld, certainly temporarily, if not altogether, on the ground that the artificial opening would be very likely to complicate the morbid action and thereby greatly enhance the patient's danger.'

C. Mansell Moullin.

FOREIGN BODIES IN THE BLADDER.—The urinary bladder is often the receptacle of a foreign body. The most common one is a broken surgical instrument. In the treatment of various urinary diseases catheters and bougies may break, and a portion be left in the bladder; or if such instruments be handled carelessly or left unsecured, they may slip into the urethra beyond reach, and ultimately into the bladder. Portions of stricture-cutting or dilating instruments, and instruments used in making caustic or other applications, have not infrequently broken off and passed into the bladder. The beak of the male blade of a lithotrite has broken off when crushing a stone; but the most serious foreign body of this kind is a lithotrite with its jaws so impacted in a stone, or bent, or jammed with calculous débris, that they cannot be approximated, making removal by the natural passages impossible. As a surgical curiosity, it may be mentioned that a small steel artery-clip was once found in the bladder of a lady long after she had made a good recovery from ovariotomy; the instrument doubtless had made its way from the peritoneal cavity by a process of ulceration. Next in order of frequency come foreign bodies introduced into the bladder by design, and left there accidentally by patients themselves. This may be done legitimately by persons anxious to relieve themselves of retention of urine or of stricture of the urethra, and who, lacking proper instruments, resort to stalks of grass or pieces of straw; but usually the motives which have prompted such self-manipulation have been most improper, or it has resulted from mere wantonness. Most extraordinary articles are sometimes introduced. The following have all been met with —hairpins, needles, pins, bodkins, straws, stalks of grass, penholders, pencils, tobacco-pipe stems, sealing-wax, glass rods, leathern thongs, string, nuts, marbles, wire, feathers, matches, pebbles, and beads.

Foreign bodies may enter by the ordinary accidents of military and civil life—as for example, bullets, fragments of shells, portions of clothing and arrow-heads, in war; pieces of wood and reeds, from falls upon such objects, and splinters of the pelvic bones from severe crushes. Then, as the result of disease (not necessarily malignant), an opening may exist between a portion of the intestine or rectum and the bladder, and fæcal matter find its way into that organ; fruit-stones and other bodies so conveyed, and too large to be expelled by the urethra, may give rise to trouble. Also, as the result of disease of the pelvic bones and of the hip-joint, portions of bone have found their way into the bladder. The bladder is sometimes the seat of a dermoid cyst, and hairs and sebaceous matter, with or without phosphatic coating, may be passed naturally or be discovered by exploration. Fœtal débris, bones, hair, teeth, have been known to find their way into the bladder. Finally, the various intestinal worms may enter the bladder by fistulous openings, and other parasites may be developed in the kidney and pass down the ureters. Hydatids occasionally find their way also into the bladder.

Consequences.—In rare cases life is immediately threatened. Death has been known to result from peritonitis, caused by perforation of the bladder by a sharp stalk of grass or other foreign body. As a rule, however, the first symptoms are those of cystitis, consisting of pain and frequency in passing water, with mucus and perhaps blood in the urine. If the offending body is not removed, it usually soon becomes encrusted with urinary salts; these are generally the phosphates, but more rarely the urates are deposited. The writer is not aware of an instance of the deposition of oxalates. The patient shortly becomes to all intents and purposes the subject of stone in the bladder, and there are specimens in many of our museums of urinary calculi having bullets, nuts, pieces of bone, &c., as nuclei.

Diagnosis.—The diagnosis is often sufficiently easy, and can only be difficult when the patient is reticent, or the foreign body is very soft, or when, as in the case of a catheter suddenly found to be without its end, the owner cannot be absolutely sure that it has not been lost since its last withdrawal from the bladder. The diagnosis can never be complete without careful sounding, and in rare cases even the digital examination of the bladder by dilatation of the urethra in the female, or by means of external urethrotomy in the male, may be absolutely necessary to clear up the case.

Treatment.—In cases of foreign bodies introduced by the urethra, unless the symptoms are very urgent, operative interference should not at once be resorted to, but every opportunity allowed for the natural expulsion of the body through the urethra. The patient should be kept at rest; if necessary an opiate may be cautiously administered; and he should be directed to hold his urine until a considerable quantity has accumulated in the bladder. He should then stand up, and with his legs slightly apart, make a free stream of urine. Such a proceeding will often cause the expulsion of a small foreign body, or it may thus become engaged in the urethra.

When, however, it is evident that the body cannot be naturally expelled, or if the case is urgent, an operation should be undertaken without delay.

Several instruments have been devised for the extraction of foreign bodies from the bladder, but as few of them are really practical, or are likely to be at hand when wanted, they need not be described here; there is one, however, for the removal of hairpins, which deserves mention, although the female urethra admits so readily and safely of dilatation that, with the finger and simple instruments, pins of all descriptions can usually be easily removed. It consists of a stout tube with a central rod ending in a hook; the hook seizes the pin, and the central rod is then screwed back into the stout tube, until the pin is bent and dragged into the tube and extracted. In addition to the usual lithotomy and lithotrity instruments (including evacuating tubes and aspirator), all of which may be found useful, the operator should be provided with a pair of nasal polypus forceps, a blunt hook on a long handle (an ordinary button-hook will do), a long urethral scoop and forceps, and if possible Sir Astley Cooper's forceps. This is an instrument like a curved metal sound; the curved end is split, and by pulling a trigger in the handle it separates laterally into two blades, which come together again directly the trigger is liberated, grasping any foreign body which may be present.

The most useful instrument for men and boys is a lithotrite; this instrument, however, requires care in its use, and special attention must be paid to three points. (1) It is not safe to crush glass in the bladder, but sealing-wax, clay-pipe stems, and other brittle materials may be safely attacked, crushed, and washed out through tubes, just as an ordinary calculus is removed by lithotrity. (2) In attempting to remove a soft or gummy body, such as the end of a vulcanised india-rubber catheter, the male blade must not be screwed home unless the body is known to be small or is felt to be seized in its long axis; for the jaws of the instrument may become jammed and the operator may be unable to remove it. (3) In seizing an oblong body it is almost sure at first to be seized transversely, and resistance will be encountered as the lithotrite and its load approach the prostatic urethra; if this is so, the lithotrite must be disengaged at once; generally after several seizures the body will be caught 'end on,' and extraction will be possible.

Women and Girls.—A careful attempt should be made to withdraw the body with a lithotrite, or with a pair of long urethral forceps, or with Cooper's forceps just described, or with a simple button-hook, if the foreign body be a hairpin. Should simple means fail, then under the influence of an anæsthetic the urethra should be dilated with a Weiss's dilator or a pair of polypus-forceps, and the surgeon's left *little* finger introduced. The nature and position of the foreign body will now be ascertained, and usually no difficulty will be met with in removing it, for the urethra admits safely of great distension, and forceps or hook may be passed along the finger and guided by it into position. If the foreign body after all should prove too large to be removed by the urethra, it may be extracted through an incision made into the vesico-vaginal septum, after which the edges of the wound should be carefully approximated and stitched up. The method of removal by incision of the urethra has few advocates. The supra-pubic method is not recommended in women. Should the foreign body owe its great size to deposits of calculous matter, lithrotrity may be practised, and the foreign nucleus afterwards extracted through the urethra; this remark is equally applicable to the male subject.

Men and Boys.—The lithotrite or Cooper's forceps should be used. If the foreign body be small, an attempt may be made to wash it out through an evacuating lithrotrity tube (No. 16 or 17 Eng.); a pebble, bead, or small pin may in this way be removed. Should the lithotrite part company with the foreign body in the deep urethra, the finger should at once be passed into the rectum and the body pressed upon from behind to prevent its return into the bladder. The finger in the rectum is often a useful adjunct in all manipulations now described, and the writer has succeeded with the finger alone in compelling the exit of a piece of catheter engaged in the neck of the bladder; and in another's practice, a shawl-pin, with a large round head, was ingeniously extracted with the finger in the rectum; the point of the pin was forced through the perineum, the pin's point was then brought well down to the coccyx, and the head thus pushed up the urethra to the meatus, whence the whole pin was withdrawn.

If all attempts at extraction by the urethra fail, the knife must be resorted to. If the patient is a boy, the ordinary lateral operation is, as a rule, to be preferred. If, however, the patient is an adult, the operation should not be more than an external urethrotomy (*la boutonnière*). This consists of a median perineal incision into the membranous urethra upon a grooved staff; a small gorget is next passed into the bladder and the staff withdrawn; the surgeon's forefinger is then passed through the dilated prostatic urethra into the bladder. After the surgeon has ascertained the exact position of the foreign body he may introduce a pair of small straight forceps and extract it. Should more space be required, the prostate may be divided downwards, and the operation converted into a median cystotomy.

G. Buckston Browne.

FOUR-TAILED BANDAGE. *See* BANDAGES.

FRACTURE-BOARDS may be made either as one piece, of sufficient size to extend over the whole bedstead; or in a number of separate pieces, long enough to reach across the bed, but only about a foot or a foot and a half wide. The latter have the advantage that they can be placed side by side over the whole bedstead, or only in the required situations. When the fracture-board is made in one piece, it is necessary to prepare the bed before the patient is placed on it; but with a number of separate pieces it is easy to slip them in or remove them without in any way disturbing the patient. The boards should be placed between the mattress and the bed.

BILTON POLLARD.

FRACTURES are divided into *simple*, where the skin is entire, so that no air enters, and *compound*, where there is a wound through which air gains admission to the broken ends of the bone—a distinction of well-known importance, both as to the danger involved and the method by which repair is accomplished. They are further classed as *incomplete* (greenstick), when, as often happens in children, the bone is only partially broken; *impacted*, when one fragment is driven into the other and there locked; *oblique*, *transverse*, *longitudinal*, and *splintered*, terms which explain themselves; *multiple*, when the same bone is broken in two or more places, or when two or more bones are broken; and *complicated*, when the fracture is combined with other serious lesions—e.g. a dislocation, the laceration of a large artery or nerve, or the rupture of some internal organ, such as the liver or bladder. In early life the epiphyses may be separated, as will be described under the fractures of the various bones.

Causes.—The immediate causes of fracture are external violence and muscular action. External violence may be direct, as in gunshot injuries, and when a heavy weight falls on the limb; or indirect, when force is applied in the long axis of the bone, as when the clavicle is broken in falls on the hand. Or a sudden twist of a bone may produce fracture. Though the patella is the bone most often broken by muscular action, the same accident may occur to the clavicle, humerus, sternum, femur, and other bones. The various conditions which, by weakening the bones, act as predisposing causes of fracture, are chiefly mollities ossium, rickets, atrophy, whether senile or from disuse—as in old joint-affections—and inflammation, with extensive necrosis or caries, especially when syphilitic or strumous, and cancer.

Symptoms.—These are divided into the *circumstantial*—as when, after an injury to the head, blood and watery fluid continue to drain from the ear, or when emphysema and hæmoptysis occur after injury to the chest—and the *direct*, which are, altered outline or length of the limb, movement of one part of the bone on the other, and crepitus. Sometimes the patient feels, or even hears, the snap at the moment of fracture. The circumstantial, though they may be strongly suggestive, generally admit of some alternative construction, and are therefore inconclusive—e.g. the flow of blood and watery fluid may be from the ear itself; emphysema and hæmoptysis may depend on ruptured lung. As to the direct; although movement is easily felt when a superficial bone is broken in the middle of its shaft, it is not so when the bone—e.g. the body of the scapula—is deeply placed, or when a small block, difficult to grasp, is detached, as in fracture through the anatomical neck of the humerus. Both these difficulties are met with in fracture of the neck of the femur. Movement is often absent, as in impacted, or very slight, as in incomplete fractures. Sometimes it is impossible, as in fracture of the base of the skull, or wrong, as in fracture of the spine, even to attempt to produce it. Alteration of outline may result, either directly from the force which broke the bone, as when the skull is driven in; or from the weight of the limb, as when the shoulder drops inwards and forwards in fracture of the clavicle; or from contraction of the surrounding muscles, the strongest preponderating, and some acting on one fragment, some on the other, as when in fracture of the femur just below the trochanters the ilio-psoas and glutei flex and abduct the upper fragment, while the hamstrings draw the lower fragment upwards behind the other. Crepitus is often unmistakable, but it is very often absent. It is so in impacted and in incomplete or greenstick fractures. In some fractures, as those through the neck of the femur, it is felt only when, by drawing down the limb, the fragments are brought into contact. Even in fractures through the shafts of the long bones, it is sometimes impossible to bring the surfaces into such close contact as to produce crepitus.

Much care is required to distinguish between true crepitus and the grating often present in rheumatoid joints, and even the creaking in the sheaths of tendons. It is often difficult to be sure at exactly what point crepitus is produced. Mobility, and crepitus, as a faint and momentary click, are sometimes to be detected only in one particular movement of the bone. They are thus easily overlooked. It is therefore necessary, when the upper part of the bone has been fixed, not only to perform rotation, but to move the part below gently in every direction. In impacted fracture, in which there is neither mobility nor crepitus, the only reliable direct symptom is altered outline. The bone may be shortened, its axis may deviate, or some irregularity of surface may, as the fingers are carefully passed over it, be detected. In doubtful cases the question whether the injury is at some point where impacted fracture is common (e.g. the lower end of the radius, or neck of the femur), the cause of the accident, and the amount of pain, must all be taken into account. Care must be taken against concluding that there is no fracture, on the ground that the patient can move, or even bear weight upon, the limb. Not rarely in fractures of the clavicle the hand can be raised above the shoulder, or even placed on the head; and patients with fracture through the neck of the femur, the patella, the fibula, or in other parts of the lower extremity — especially when there is impaction—have been known to walk long distances on the limb.

From what has been said it will be seen that it is often impossible to secure positive proof that fracture has occurred. This is especially the case when the bone concerned is one of a series closely knit together, as in the carpus or metacarpus, or, even when, of two bones lying side by side, only one is broken—e.g. the ulna or fibula. And it may be as difficult to deny as to affirm that fracture is present. Yet it is highly inadvisable to endeavour, by forcible and prolonged examination, to obtain conclusive evidence. Our duty is, if doubt remains after all reliable means have been critically used, to adopt such precautions as may provide for safety, should fracture after all exist; to watch carefully the progress of the case; and to act on such further knowledge as may be obtained at any later stage. What reasonable patient would ask for more than this? In many cases an anæsthetic should be used. When the muscles by this means are relaxed, gentle manipulation will often elicit evidence which, without it, even forcible and painful movement of the limb would fail to disclose. An anæsthetic, however, it must always be remembered, is not given that rough manipulations may be practised—these are as dangerous when the patient is insensible as when he is conscious, and have often done irreparable harm.

Another point is that the limb is to be thoroughly exposed, and minutely compared with the opposite side. A complete examination should be made as soon after the accident as possible and before great swelling is present, so that accurate diagnosis has become out of the question. The diagnosis between fracture and dislocation may sometimes be difficult; nor must we forget that these two conditions may exist together. In fracture there is preternatural mobility; deformity is easily removed, but it returns when external support is withdrawn, and there is generally crepitus. In dislocation the limb is fixed in an abnormal position; there is no true crepitus; when its upper end is grasped and the shaft is rotated, it is felt to move in one piece, and the bone when once replaced, remains in position. Moreover, its various salient points can be felt in their normal relations to the rest of the bone, but the relation of the bone to its socket is changed. As rheumatoid joints often present grating, we must be careful not to conclude that what we feel is true crepitus without taking other symptoms into account.

Summoned to a fracture, the surgeon's first care must be to provide against further injury. The patient must be induced to remain as still as possible while preliminaries are arranged. The clothes covering the limb must be removed by cutting along the seams, and the limb must be securely supported by extempore inside and outside splints formed of pieces of board (thickly doubled newspapers will suffice for the upper extremity), a strong walking-stick, &c.; a shawl or thin pillow being used to protect the skin and distribute pressure. The patient must now be placed on a stretcher, or a door covered with spare clothes or straw, the surgeon himself taking charge of the limb, while he directs the bystanders how, acting steadily together, to lift the sufferer. The patient should be hand-carried if this is practicable, as the jarring of any conveyance may do serious injury. He must be lifted to bed with as little disturbance as possible, and placed on a narrow bedstead with a firm mattress, with a board beneath the latter to keep it flat. A feather bed is quite unsuitable. Some surgeons have advised that the fracture should not be 'set' before the third or fourth day. This, however, is an exploded view; adjustment should be effected with the least possible delay.

In the treatment of fractures three objects present themselves: (1) the replacement of the fragments; (2) their maintenance in position during repair; (3) the prevention or removal of complications. The difficulties which arise vary with the case. In the clavicle the displacement depends mainly on the weight of the limb, which falls inwards and forwards—little on spasmodic muscular action. Hence adjustment is easily effected by lifting the limb into its normal position. The difficulty here is to maintain reduction. In oblique fracture of the femur or tibia it is the powerful muscles of the limb that oppose reduction. In fractures of the surgical neck of the humerus the muscles inserted into its tuberosities rotate the upper fragment; and this is so deeply situated that we can sometimes neither learn its exact position nor turn it back into its place. Sometimes the mere irregularity of the fragments, or the presence of soft parts between them, hinders adjustment. To effect reduction the limb above must be fixed by an assistant, while extension is made below, as far as possible in the long axis of the upper fragment, the surgeon himself guiding the ends into place. In some instances of fracture of the tibia reduction cannot be effected till the tendo Achillis has been divided; but tenotomy, either here or in other fractures, is very seldom called for. Sometimes, in fractures of the femur, shortening cannot at the time be entirely removed; but it may gradually be subsequently overcome by weight-extension. Position sometimes assists—e.g. flexion of the leg on the thigh during the reduction of fractures of the tibia. An anæsthetic is often called for, not, of course, as before stated, that violence may be used, but because it obviates resistance which must otherwise be forcibly overcome.

If practicable the fragments should be at once exactly adjusted; but rather than make violent or over-long attempts, we must secure the best attainable position at the time, and improve this, so far as may be possible, by subsequent modification. If such swelling has occurred that neither a complete diagnosis nor satisfactory adjustment is possible at the time, the limb must be brought as far as may be into its normal position, such apparatus as can be used without restricting the circulation must be employed, ice-cold lotions must be applied, and the limb be placed in the best position for the subsidence of the swelling. The surgeon must wait for the earliest opportunity of completing reduction, whether by using more extension, the insertion here and there of pads, or even an entire re-setting, though this is generally both unnecessary and unadvisable. In using retention-apparatus we must provide efficient support, so as to guard against displacement due either to (*a*) the weight of the limb, (*b*) muscular action, (*c*) the movements of the patient; avoid all constriction, especially above the fracture; distribute pressure, and prevent its occurrence over prominences or tender areas; and place the limb in the most comfortable position, remembering that in a very few hours after a fracture is properly adjusted the patient ought generally to be free from pain in the limb, remembering also that considerable swelling is in prospect. This latter must be taken into account while the fracture is being put up, and very carefully watched subsequently. Tight bandaging not only causes pain, but may lead to gangrene or other serious consequences. It is dangerous to place strapping in a circular direction round the limb, and cover it with a bandage; should swelling occur below, we are apt, while loosening the bandage, to forget the strapping, and so fail to remove the constriction. Such an oversight has sometimes led to gangrene of the limb. For the first few hours the condition of the circulation in the fingers or toes should be carefully watched.

Complications.—(*a*) The soft parts may have been so extensively crushed that sloughing ensues, and the fracture becomes compound—no rare event in the case of the tibia and other superficial bones. Should this be threatened, the area involved should be protected by antiseptic dressings, and the subsequent treatment will be that for compound fracture. *See below.*

(*b*) Extravasation of blood may cause tense swelling and so lead to gangrene, especially if the bandages are tight. To avert such a result all circular constriction must be at once removed, the limb, supported in loosely adapted splints, must be raised (the same end may to some extent be attained by raising the foot of the bed), and if the surface be hot, evaporating lotions must be used. If however, the limb is cold, it should be wrapped in cotton wool. Bullæ should be pricked and emptied, but the cuticle must be carefully preserved.

(*c*) Rupture of the main artery, a grave accident, is happily rare. It is chiefly met with in fractures of the upper end of the humerus, the lower end of the femur, and the upper end of the tibia. The symptoms are: the rapid formation of a tense elastic swelling, in which a distinct thrill or even a faint diffused pulsation may often be felt; loss of sensation and coldness of the limb, and loss of pulsation in the vessels below. The choice of treatment is embarrassing. Three courses present themselves. To trust to compression or ligature of the artery higher in the limb; to endeavour to find and tie the two ends of the vessel; to perform amputation. This last step should not be taken till gangrene has absolutely set in, for the symptoms mentioned are not proof positive that the artery is torn, and recovery has sometimes occurred although they were all present. To search for the ends of the vessel is a proceeding surrounded with such difficulty, and involving such free dissection of the soft parts, that, although it may occasionally be justifiable, it cannot be recommended. The safest plan, generally, will be to try the effect of pressure on the artery above, applied if possible by the digital method, so that the return of venous blood is as little as possible interfered with. Ligature of the vessel above is, as a rule, unadvisable. Compression secures the same end, and can be remitted should swelling cease to increase, while ligature, by suddenly arresting the circulation, may precipitate gangrene. Where gangrene has supervened, amputation should as a rule be at once performed; though it may be right to postpone it when the patient is very old or very weak. The point selected must vary with the case. When the artery has been wounded by one of the fragments in a fracture produced without much violence, amputation may be performed just above; but when the fracture has been accompanied by extensive injury of the soft parts, amputation must be done at some distance higher in the limb, where the soft structures are uninjured. If this rule is not followed gangrene will probably reappear in the stump. The inference to be drawn from the appearance of bullæ varies in different cases. They result from extravasation around the fracture, and indicate extensive laceration. When the limb is cold and numb, bullæ are but another sign that gangrene is at hand. But when the surface is warm, and there is pulsation in the vessels below, bullæ may be regarded as evidence that serum is reaching the surface, and that tension is being relieved. *See* Arteries, Wounds of; Femoral Artery, Wound of the.

(*d*) Dislocation is sometimes produced by the same force which caused the fracture. This is a complication which may prove very difficult to manage, especially when one fragment is short and deeply placed, as in dislocation of the head of the humerus accompanying fracture high in the shaft. The possible existence of this condition must not be overlooked, nor can such a complication well escape notice during a careful examination, unless considerable swelling has already taken place. In any doubtful case examination must be repeated as soon as swelling has subsided. Reduction should be, when practicable, at once effected, but the attempt has often failed. It may sometimes be accomplished by enclosing the limb securely in splints, so that a firm hold is gained on the displaced end of the bone; and then, when the muscles are relaxed by an anæsthetic, employing the method by manipulation. *See* Dislocations. Failing reduction, the fracture must be adjusted in the best available position. When union has occurred —that is, in six or eight weeks—manipulation may be again tried; but at this period reduction generally cannot be effected, and the case must be treated as one of unreduced dislocation: adhesions must be broken down by careful manipulation, under an anæsthetic, when union of the fracture is firm, and passive movements must be employed with perseverance, to secure such motion as can be obtained. *See* Humerus, Fractures of the.

(*e*) When fracture extends into a joint, mobility may be permanently and considerably impaired by sharp synovitis, followed by adhesions; by the displacement of fragments which cannot be adjusted; or by the formation of callus, altering the shape of the articular ends. This is especially apt to be the case in comminuted Colles's fracture extending into the wrist-joint, and in fracture of the humerus just above the condyles, extending into the elbow-joint, particularly in children. In such cases the utmost care must be taken in the adjustment of the fracture, though the swelling which so quickly results may defeat this object. The surgeon in such instances should do himself the justice of at once explaining the state of the case to the patient.

(*f*) Œdema of the limb is often a troublesome complication. Following immediately on the fracture, it depends on copious serous effusion from bruising of the soft parts; it may depend entirely on tight bandaging; or, slowly ensuing some days after the accident, it arises from plugging of the veins in the neighbourhood of the fracture—a condition especially apt to occur in gouty or rheumatic subjects. In these cases fatal embolism may result from the detachment of thrombi and their passage into the lungs, or hemiplegia may occur from their transit into the arteries of the brain. Acute œdema, from phlebitis, must be treated by raising the limb and relieving circular pressure; the more chronic forms, often very obstinate, by frictions, shampooing, and by the application—when union of the fracture is firm—of Martin's elastic bandage, which is very efficient for the purpose. The treatment, however, must be gently conducted, or the phlebitis, always very prone to relapse, will be renewed.

Compound Fracture.—The gravity of compound, as compared with simple, fractures depends, to some extent, on the admission of air. But the danger accruing from this source has of late years largely diminished. Formerly, when sanitary conditions were neglected, the air which entered a wound was almost invariably charged with some septic material, so that a true inoculation of the tissues occurred. But now, when ventilation is amply provided, when all infectious cases are removed from the general wards, and when wounds are treated, whatever the details of dressing may be, on antiseptic principles, the mere admission of air is much less deleterious than it was twenty years ago. This is constantly demonstrated by the safe repair of that form of compound fracture which is artificially produced in the operation of osteotomy, in some instances of which, when a wedge of bone is removed, an opening larger than that of many compound fractures is made, and air is most freely admitted into every part of the wound. Compound fractures, however, are generally the result of much greater violence, and are attended with proportionately greater injury to the soft parts than is the case with simple fractures. Often the skin is widely stripped off, the muscular structures are reduced to a pulp, the main vessels or nerves are lacerated, and the bone is extensively comminuted. These injuries are the main sources, at the present day, of the dangers attending compound fracture.

Treatment.—Should either of the fragments—it is usually the upper—protrude through the skin, reduction must, if necessary, be assisted by enlargement of the wound at the point of greatest resistance. Should the fragment protrude far, and be completely bare of periosteum, or should reduction be otherwise impossible, a portion of the bone must be sawn off. The danger of this latter proceeding, as increasing the liability to pyæmia, osteomyelitis, or necrosis, has been exaggerated. Of course no part of a bone should be lightly sacrificed, but the removal of an end which is found to materially hinder reduction after the wound has been enlarged, is less objectionable than forcible and prolonged manipulation. In comminuted fracture, fragments which are completely loose should be removed; those which, though broken away from the rest of the bone are still covered in their whole length with periosteum, should be carefully replaced; while those which are partially bared must be dealt with according to circumstances. In young subjects they may be left, as also when on account of their depth from the surface they are difficult to reach. The condition of the soft parts may have some influence on our decision. When the surrounding injury is comparatively slight, so that nutrition will probably soon resume its ordinary course, they may remain; but when, especially in middle-aged or elderly persons, there is extensive crushing of the soft parts, with a prospect of long suppuration, in the course of which they would almost certainly perish, it is safer to extract any that are easily reached. Hæmorrhage must be arrested by ligature (with carbolised catgut), or by torsion. In order to do this, when bleeding is deeply seated, it is necessary freely to enlarge the wound (an Esmarch's bandage having been applied, or the artery being compressed above), to turn out all clots, and tie both ends of the vessel. *See below* on Amputation.

If large nerves are torn, their ends must be brought together by two or three fine catgut sutures passed through their sheath. The wound must then be thoroughly cleansed, and washed out in all its recesses with a 1 in 20 solution of carbolic acid in water, introduced by means of a gum-elastic catheter fitted to a syringe or to an irrigator. The surface of the limb must be well washed with the lotion; coagula, as far as possible, should be removed; a counter-opening for drainage, maintained by a tube or by a strip of guttapercha tissue soaked in the lotion, will often be advisable. The opening in the skin, if extensive or branched, may be partially closed; but an ample outlet for free drainage must be left. A strip of 'oil-silk protective,' or gutta-percha tissue soaked in a 1 in 40 solution of carbolic acid, is placed over the wound itself, and the limb is widely enveloped in the neighbourhood of the fracture with gauze wrung out in the carbolic solution, and more superficially with eight or ten layers of antiseptic gauze, having a sheet of thin mackintosh between the outermost and the next layer. The quantity and the covering extent of the gauze must depend upon the probable amount of discharge. The dressings must be so applied as to admit of easy removal, without disturbing the fracture; and they must be changed often enough to prevent the discharge from escaping beyond them. They should be renewed, usually, on the second or third day, and then according to circumstances. If the wound has been long exposed to the air, it should not only be syringed out with carbolic lotion as directed, but iodoform powder should be dusted into the wound and between the fragments. A convenient dressing, when the wound is small, consists of oil-silk protective covered with folds of lint soaked in a saturated solution of boracic acid. *See* Antiseptic Surgery.

Mr. Sampson Gamgee's method of dry dressing is also excellent; or absorbent cotton-wool impregnated with iodoform, and covered with mackintosh, may be used; or the wound may be thoroughly washed out with a solution of one part of tincture of iodine to five hundred or a thousand parts of water. The condition of the limb, as the neighbourhood of the fracture is thus covered in, must be closely watched by observing the temperature, sensation, and circulation in the parts below. Great care must be used that the dressings are not applied tightly, but that some allowance is made for swelling, which will in all likelihood ensue. These dressings may be discontinued as soon as the wound has healed.

Amputation.—The treatment of wounds has undergone so complete a revolution during the last twenty years, that the rules for amputation in compound fracture have had to be recast. Conservative surgery has been carried to a point which it would formerly have seemed impossible to reach, and highly dangerous even to attempt. The change is shown in the greater rarity, not only of primary amputations, but of secondary also. The effort to save the limb is commonly justified by the result. Amputation, however, must still be performed in cases in which, without reckoning such complications as in former days threatened all large wounds—secondary hæmorrhage, cellulitis, prolonged suppuration, and the like—the fate of the limb is already sealed. As when all the soft parts are completely torn through, or when some considerable portion has been torn away in a machinery accident; when the whole thickness of the limb is completely crushed; when large areas of skin have been stripped off; when, with other formidable injuries, a large joint is torn open and its ligaments ruptured; when the main vessels and nerves of the limb are severed; when deep hæmorrhage is profuse, and the vessel cannot be reached without a wide, and therefore destructive, dissection of the limb, as when the popliteal, or the upper part of the posterior tibial artery, is lacerated. Conditions other than local must also have due weight—the patient's age, habits, and the presence or absence of visceral disease, especially of the kidneys. In the old, and in persons of unsound health, amputation is a formidable measure, and the choice between the risks of leaving the limb and of amputation are so evenly balanced that the case is one of great difficulty, and every point must be critically considered.

In young and healthy subjects, if the main artery is wounded, its two ends must be tied; if the main nerves are torn, their cut ends must be brought together by two or three carbolised catgut sutures, passed through their sheaths; if a joint is opened it must be thoroughly washed out with carbolic lotion (1 in 40) and provided with free drainage, and an attempt must be made to save the limb; for amputation, should it become necessary, can be performed later. But in deciding what our course should be, we must always bear in mind that our first charge is the safety of the patient's life; to save this we must not hesitate to sacrifice the limb. Should gangrene ensue, amputation must, unless contraindicated by the general condition of the patient, be immediately performed. In the later stages of the case, should secondary hæmorrhage of formidable amount occur (happily this is very rare), and be repeated in spite of compression of the trunk above; if suppuration is so copious that the patient is becoming dangerously weak; or if the fracture involved injuries which have disorganised the limb so that repair seems hopeless, secondary amputation must be resorted to.

In fractures which are attended with only moderate displacement and laceration of the soft parts, and are subsequently kept at rest, the callus is limited to the interval between the fragments, whether between their ends, or where they overlap. But when the soft parts have been widely injured, so that inflammation is considerable, or when the fragments cannot be kept at rest, as in fractured rib, so that inflammation is prolonged, callus is formed both in the medullary canal (interior callus), and in the parts around (ensheathing). These varieties are termed provisional. They exist during the process of repair, but are subsequently entirely removed; so that when normal repair is complete no callus remains but that which lies directly between the fragments. In compound fracture union takes place—after any sloughs that may have formed have been either extruded or absorbed—by the development of granulation-tissue between and around the fragments, and its subsequent ossification. The period occupied by repair varies widely with the degree of injury, and is extended by the tedious separation of sloughs and sequestra, and by the difficulties which attend healing where soft parts have been extensively destroyed. But it is generally twice or three times as long as that required in simple fractures. After union is complete, a process of modelling occurs, by which projections are rounded off, all superfluous callus removed, and the medullary canal re-formed, so that the bone is restored, in respect alike to its size and outline, density and strength, as far as possible to its original state. This is so perfectly effected that in many instances, even on section, no trace of the fracture remains. Union takes place very rapidly in children, and may be complete in ten to twenty days; in older persons it extends over—speaking approximately—six or eight weeks, and is more slowly effected the larger the bone concerned. The bones of the lower, perhaps because they are larger, unite somewhat more slowly than those of the upper extremity.

In fractures of the upper extremity splints may, as a general rule, be removed, and the patient be allowed gradually to resume the use of the limb, at the end of a month or five weeks. For the lower extremity, as it has to sustain the weight of the body, this time must be extended to seven or nine, or even twelve weeks, according to the age and the circumstances of the patient. But in each case the patient must be guided by the advice of his surgeon, given after a careful examination has been made, for sometimes union is found to have been unexpectedly delayed. Should any yielding be observed, he must be forthwith directed to abstain for a time from bearing weight on the limb. Great and unmanageable deformity will otherwise supervene; witness the distortion of the leg which sometimes gradually ensues after Pott's fracture. Various, some of them fanciful, causes of delayed union have been assigned, Those calling for mention here are (*a*) local, (*b*) general. The first include defective apposition of the fragments, want of rest, the intervention of some of the soft structures between the fragments, necrosis, and in compound fracture considerable loss of substance, as when fragments have been extracted, or bone has, to facilitate reduction, been cut away; the ligature of the main artery for hæmorrhage; and, probably, injury of the large nerves of the limb. The second comprise atrophy, as in the very old, or that which occurs from long disuse, scurvy, the advanced cachexia of syphilis, or that attending the later stages of cancer, and, according to some observers, pregnancy. The influence of these causes has, doubtless, been exaggerated. *See* UNUNITED FRACTURE.

Consequences of Fracture.—Fat-embolism may occur after fracture involving the medullary canal. *See* FAT-EMBOLISM. Necrosis is extremely rare, if, indeed, it ever occurs, after simple fractures. In compound fractures it is not rarely met with. It may be suspected in cases in which, though the surrounding structures have become sound, openings leading down to the bone remain long unclosed. Under these circumstances an examination involving as little disturbance as possible should be made, and any dead bone that is discovered should be removed. Sequestra generally consist of fragments of compact tissue. They may sometimes be extracted more easily when divided by a fine chisel. The rapid development of new-growths in the site of recent fracture is to be noted. Atrophy, sometimes very marked, may follow the interruption of the blood-supply to the bone, resulting from rupture of its medullary artery. For individual fractures, *see* separate bones. HOWARD MARSH.

FRAGILITAS OSSIUM.—This is an old term, which has gradually fallen out of use as the more exact pathology of the various conditions under which the bone is more than usually brittle has become better known.

The chief morbid process with which it was most frequently confounded—osteomalacia—will be considered in another article. Fragility was scarcely a proper term to apply to cases of osteomalacia, for the bones more frequently bend into all sorts of odd shapes in the latter disease than break with a clean fracture. Simple atrophy of bone from various causes will here alone be considered as the condition giving rise to fragilitas ossium. Cancer and tumour of bone, in which spontaneous fracture occurs, will be considered under their proper heading of TUMOURS OF BONE.

Causes.—In old age the bones, like other tissues, undergo fatty degeneration, and, becoming more brittle, are liable to fracture from insignificant injuries. Long confinement to bed during a lingering illness in the adult, will sometimes produce the same effect; that is to say, the bone may atrophy from want of use, and become so brittle as to break. It is also well known to surgeons how light and porous the bones of a limb become in which one or more joints have been diseased and kept at rest for any length of time.

This atrophy from disuse may in some degree explain the ease with which a patient who has been kept in bed for six weeks or two months for fracture of the femur breaks the other thigh-bone, when he gets up and begins to move about. The bone may even break in the neighbourhood of the original fracture from the same cause. And Curling has shown very clearly that another factor plays an important part in such atrophy. He maintains that when the line of fracture crosses the nutrient artery, the osseous tissue supplied by that vessel undergoes atrophic changes.

In insane patients, and especially in cases of general paralysis, the bones sometimes break from very slight injuries. And although there is frequently some little difficulty in proving the absence of any undue violence on the part of the attendant, yet it is an established fact that the bones may be very fragile. This is generally due to atrophy and fatty degeneration, arising probably from the low and depressed vital condition of such patients. It has been asserted that the bones may be found in the condition described as osteomalacia; but, in the writer's opinion, there is insufficient evidence that this is by any means common in the fragilitas ossium of the insane.

A somewhat similar condition of atrophy and thinning of the bones has also been observed in the advanced stages of carcinoma, especially in that of the breast, without any deposit of new-growth in their substance. The cachexia induced by the carcinoma would seem here to be the cause of the atrophy and consequent fragility. In some cases rheumatism or syphilis has been present before the occurrence of such evidence of a feeble condition of the bones. But in others no history of these constitutional affections has been obtainable. Some of the cases referred to by Stanley are remarkable for the extraordinary number of fractures, and the early age at which they occurred. In one, a girl of fourteen, there were no less than thirty-one fractures in different bones, the first occurring at the age of three years. 'In a sister of this patient, six years of age, there was the same condition of the bones favouring the occurrence of fractures. She had suffered nine fractures since the age of eight months.' In another, to which he alludes, a boy aged ten years had been the victim of eight fractures—six in one tibia, and two in the femur. There was no difficulty in obtaining their union, a fact which is quite unlike the history of cases of osteomalacia. A decided hereditary tendency to this condition of the bones has been proved to exist in a small proportion of the cases recorded. In infantile paralysis the affected limb may exhibit the same symptoms from a feeble condition of the bones, but this is due to a want of development from disease of the spinal cord.

Pathology.—In the atrophy of old age the bones become light, spongy, and more porous. The spaces in the cancellous tissue coalesce by absorption of the osseous trabeculæ, whilst the cortical tissue becomes more and more cancellous, till finally the bone may be reduced to a mere shell filled with yellow fat. In this senile atrophy the lime-salts are not absorbed, leaving the organic matrix to represent the bony outline, as occurs in the early stage of most, if not all, the cases of osteomalacia; but, on the contrary, the part which has not yet entirely disappeared, and been replaced by fat, contains more than the usual proportion of lime-salts, and is consequently more brittle. In osteomalacia, on the other hand, the texture of the bone is at first softened by the absorption of its lime-salts, and bends rather than breaks. So much for the contrast between senile atrophy and osteomalacia. The question then appears to be whether atrophy of bone, arising from other causes than simple old age, is similar in its pathology to senile atrophy or to osteomalacia; and secondly whether there is a fragility of bone besides that due to osteomalacia, occurring in young or middle-aged people, to which no definite cause can be assigned other than simple atrophy of bone. To the first of these questions the answer would seem to be fairly definite, that the atrophy and consequent fragility arising from some definite cause, such as long-continued disuse, resembles most completely the changes occurring in senile atrophy. To the second question a less definite answer must be given, as the cases are so excessively rare that few can have been observed by any one man.

The cases recorded by Stanley would seem to indicate that there is an atrophic condition of bone, occurring at almost any age, resembling, in its morbid anatomy, the changes naturally arising in old age, and to which no definite cause, such as disuse, can be ascribed. Stanley thus concludes: 'Still, however, it is not clear that this condition of the bones, disposing them to fracture from the slightest causes, is a different disease from that which was previously described (osteomalacia), wherein the thinning of the walls was accompanied by softening of the texture of the bones, disposing them to bend rather than to break, since between these two states of the osseous system there is really no other observable difference than in the relative proportions of the animal and earthy constituents of the affected bones; their chemical constitution is the same.' But, in the writer's opinion, this is quite a sufficient difference to separate the two conditions of atrophy of bone and osteomalacia, especially when the clinical symptoms and history of the latter are taken into consideration. *See* OSTEOMALACIA.

Symptoms.—Beyond the lightness of the affected bone, and the tendency to fracture from trivial causes, there is nothing to point out as indicative of atrophy of bone. The surgeon will, however, know from the history of the case—for example, in continued disuse of a limb from any cause—that the bones so treated are liable to atrophy, and consequently may be easily broken. In the other class of cases, in which the atrophy seems to arise spontaneously from no ascertainable cause, the first indication of the presence of the disease will be the occurrence of fracture from some trivial accident.

Treatment.—In senile atrophy, and in atrophy from other causes, the bones very readily unite. Professor Humphry has lately (*Brit. Med. Jour.*, Feb. 1884, p. 55) proved that in old people fractures unite as readily as in the young and middle-aged; and in the atrophy from other causes than age, the histories of the cases which have been recorded tend to prove that there is no delay in their union. It is therefore necessary to treat these fractures exactly on the same grounds as ordinary fractures, except that the surgeon should most carefully search for any clue in the patient's history pointing to a constitutional cause, and attempt, as far as possible, to rectify the defect if such be found. There cannot be said to be any special treatment even when the atrophy giving rise to the fragility of bone is discovered. H. H. CLUTTON

FRECKLES. *See* LENTIGO.

FRICTION. *See* MASSAGE.

FRONTAL SINUS, Diseases of the.—Distension of the frontal sinus from pent-up secretion, or pus, sometimes called abscess of the frontal sinus, may so closely resemble an orbital tumour as to render a diagnosis difficult without making an exploratory incision.

Causes.—Distension of the frontal sinus is usually due to an injury, in many cases very remote from the symptoms which first attracted attention to the eye. The extent, however, to which the sinus is often found dilated, and the time which must be required to produce such distension of a bony cavity, together with the oft-told tale of a blow or fall years before, can only lead to the conclusion that an injury is the most frequent exciting cause of these accumulations. The explanation is probably that at the time of the accident some of the anterior ethmoidal cells were fractured, and that the infundibulum, the canal by which the secretion from the frontal cells escapes into the nose, had been blocked. This channel being thus closed, there is retention of all mucous secretion, which slowly accumulates and gradually expands the sinus. In one case of extreme distension of the frontal sinus in a man æt. 58, under the writer's care, the disease was clearly traced to a kick received on the left eyebrow from a horse when four years old, fifty-four years previously. The left eye was considerably displaced by the tumour; it was half an inch further from the nose, and nearly an inch lower down in the face than its fellow on the opposite side. The eye was projected outwards, and the patient was unable by any effort to draw it inwards. This case was greatly benefited by treatment, and the eye regained to a large extent its proper position within the orbit.

A case has also been recorded by Mr. Hulke of a girl æt. 17 with great expansion of the right frontal sinus, which was evidently caused by an accident when she was four years old. 'She fell from a window and received a cut over the right eyebrow. Her forehead was much bruised and swollen, and she had concussion of the brain.'

There are, however, cases of distended frontal sinus in which no history of an injury can be traced. It is probable that in these cases an inflammation of the lining mucous membrane, or some other cause which we cannot detect, has closed the communication between the frontal cells and the nose, and thus allowed the secretions of the frontal sinuses to accumulate and distend them. This hypothesis is the probable explanation of a case of great distension of the frontal sinus in a girl æt. 21, who was attending at the Royal London Ophthalmic Hospital, and who had never received an injury. Her mother dated the disease from an attack of erysipelas of the head and face when she was six years old.

Symptoms.—In most cases the distension of the frontal sinus is *chronic*, the collection of fluid within its walls being the pent-up secretion of many years. Sealed up in a bony cavity no decomposition of the fluid ensues, and, increasing year by year in quantity, it distends the sinus and displaces the eye. There is frequently no pain, not even a sense of weight over the brow. The only symptoms which are manifest to the patient are the gradual formation of a tumour at the upper and inner portion of the orbit, and a slow but steadily increasing protrusion of the eye downwards, outwards, and forwards. The disease is usually confined to one frontal sinus, but cases have been met with in which both frontal sinuses were affected. Occasionally a chronic distension of the frontal sinus will become acutely or sub-acutely inflamed, and there will be a feeling of constant heaviness and aching across the forehead, with tenderness on the inner side of the orbit, which will compel the patient to seek for advice.

Acute inflammation and distension of the frontal sinus is rare, but still it does occur and should be recognised. There is a dull aching pain over the brow and root of the nose, accompanied by considerable constitutional disturbance. The pus gradually accumulates in the frontal sinus, and ultimately discharges itself either by bursting into the nose, or by making an exit for itself through the upper and inner part of the orbit. When the latter site is selected there is usually some bulging of the distended sinus into the orbit, and a slight displacement of the eye downwards and outwards. The upper lid becomes red and swollen, and the tumour, examined with the finger, is tender, and will, if sufficient thinning of the bone has taken place, impart a sense of fluctuation.

Treatment.—The objects to be attained are, first to evacuate the pent-up fluid, and then to establish a free communication between the frontal sinus and the nose, through which the secretion may continue to drain as fast as it is secreted. By these means the cavity of the sinus will gradually collapse, and the eye will be restored in a great measure to its normal position. The ends to be desired will be accomplished by the following operation:—

A single curved incision parallel with the fold above the lid is to be made over the most prominent part of the tumour, and having by a little dissection exposed its surface, the scalpel should be plunged into it, and an opening made to the extent of the incision. The index finger of the right hand is now to be pushed into the sinus through the wound, to ascertain the size of the cavity and if there is any necrosed or carious bone. Whilst thus exploring the sinus, the little finger of the left hand should be passed up the corresponding nostril, and an endeavour made to find out the spot at which the tip of the finger in the sinus will approximate most closely the end of the one in the nose. After a little search it will be found that at one part the fingers will almost meet, there being only a thin plate of bone between them. Having gained this information, the finger in the frontal sinus is to be withdrawn, but that in the nostril is to be retained *in situ* to act as a guide to the gouge or elevator, which is to be passed into the sinus and made to force a passage into the nose through the lamina of bone on which the tip of the little finger is resting. A communication between the frontal sinus and the nose having been thus established, an india-rubber drainage-tube, with holes cut at short distances, is to be introduced, one extremity of which is to be afterwards fastened on the forehead, whilst the other end protrudes slightly from the nostril.

The easiest way of introducing the drainage-tube is to pass a probe with an eye up the nostril and out of the wound, and having fastened the tube to it by means of a piece of string, to draw it back again through the nose.

The object of the drainage-tube is to keep the channel between the two cavities from closing, and to enable the attendant to wash out the frontal sinus at least twice a day with some astringent and disinfectant solution. For the latter purpose a lotion of alum gr. iij., sulphate of zinc gr. j., to the ounce of water; or a lotion of carbolic acid ♏iij. to the ounce of water, may be injected with a glass syringe through one of the openings at the upper extremity of the tube. The drainage-tube should be worn for five or six months, or until all discharge from the nose has ceased. The results of these cases when thus treated are usually most satisfactory.

Tumours of the Frontal Sinus.—The tumours which are met with in the frontal sinus are—

1. Those which originate in the frontal or ethmoidal cells; or, in some cases, in the sphenoidal cells at the base of the skull. These are usually bony or ivory exostoses.

2. Those growths which originate in the nose, antrum, or adjacent locality, and afterwards extend into the frontal sinus.

1. Ivory exostosis is the tumour most frequently met with in the frontal sinus. It grows in two ways:—

(*a*) As a sessile tumour, which is connected with the portion of bone from which it sprang by a very small pedicle; it then occasionally becomes detached, and remains as a loose bony tumour within the cavity of the distended sinus.

(*β*) As a tumour with a broad base, which increases with the growth of the tumour.

Ivory exostoses in their growth extend forwards and downwards into the nose and orbit, and frequently also backwards into the cavity of the skull.

A case of large ivory exostosis was reported by the late Sir William Fergusson. The weight of the bony growth removed was 10½ ounces, or 5,040 grains. Another case has been related by Dr. Duka. The weight of the bony growth removed was 1,060 grains.

Mr. Bryant, in his *Practice of Surgery*, has also recorded a case of ivory exostosis which he enucleated from the frontal sinus of a man æt. 24, which had been growing for four years.

Treatment.—In all cases of bony growth within the frontal sinus it is necessary to proceed with extreme caution. When the tumour is connected by a very small pedicle with the adjacent bone, it may generally be easily detached and turned out; but if it is found to be connected by a broad base to the cranial bones, it is better to make no further attempt to remove it.

2. Of the tumours which originate in the nose, antrum, or adjacent locality, and extend into the frontal sinus, we have:—

(*a*) The polypoid growths. These may start from the nose and extend upwards into the frontal sinus, and completely distend it so as to form a tumour, bulging the inner wall of the orbit and displacing the eye.

(*β*) The fibroid polypi, which grow from the base of the skull and make their way into the nose. These also sometimes extend themselves into the frontal sinuses.

A very remarkable case of a large tumour which occupied the nose, both frontal sinuses and upper maxillary bones, was reported by the late Mr. Moore, of the Middlesex Hospital, in the *Pathological Transactions*, vol. xix. p. 332, under the heading of Cranio-facial Enchondroma. The deformity in this patient was excessive. Both eyes were displaced outwards, and the width between the inner angles of the two eyes was four and a half inches. There was a huge protuberance of the upper part of the face, caused by the distension of the cavities which were filled with the tumour.

The tumour was examined by the Morbid Growths Committee of the Pathological Society, who described it as a compound growth of myxoma and enchondroma. The preparation is in the Middlesex Hospital Museum, No. 539.

Fracture of the frontal and ethmoidal cells is occasionally produced by blows on the face. The injury is recognised by an escape of air into the cellular tissue of the face on the patient forcibly blowing his nose.

Treatment.—The patient should not blow his nose, and in a short time the emphysema will entirely disappear, and in a few days the fissure in the bones through which the air escaped will be completely closed.

George Lawson.

FROST-BITE.—Any uncovered part of the body when exposed to the continuous action of intense cold becomes at first red and tender, next hard, white, and insensitive, and at last passes into a state of dry gangrene. In frost-bite which is caused by the action of cold air on peripheral and exposed organs, such as the nose, external ear, and fingers, the lesions are not so rapidly produced, and each of the above stages is well-marked and more or less prolonged. In a division analogous to that of burns the lesions produced by the action of cold were arranged by Callisen in three degrees: the first, of erythema; the second, of vesication and superficial ulceration; and the third, of gangrene.

In the erythematous state the well-known condition is met with, in which the skin is rendered deep red or livid on temporary exposure to a frosty air, and subsequently, when warm, becomes very painful and slightly swollen. In the second degree, caused by more prolonged or frequently renewed application of cold, the epidermis is raised in small blisters and the skin becomes raw. In the extreme forms of this degree the whole thickness of the cutis becomes inflamed, large blisters containing blood-stained serum are formed, and the affected surface is threatened with complete disorganisation.

Gangrene from frost-bite presents a variety of forms, and is influenced by the intensity of cold, the duration of its action, and the condition of the affected part. In the very rare instances in which it is caused solely by the action of very intense cold, the frozen skin first becomes white and firm, like a surface acted upon by the ether spray, and then passes into a state of dry gangrene, the integument becoming black and inodorous and hopelessly disorganised. In the more frequent form of frost-bite the gangrene is moist, and due either to too rapid application of warmth to a livid and incompletely frozen surface, or to the prolonged action of moderate cold combined with wet. In some few instances the gangrenous part becomes 'mummified,' being quite dry, though soft and pliable, and separating very slowly from the adjacent sound parts.

In most cases of gangrenous frost-bite the causation is complex, as the action of cold is assisted by that of other conditions. Debility from insufficiency of nourishment and from fatigue has undeniable influence, as is proved by the records of military surgery, and by the fact that frost-bite, once so prevalent amongst Lascars, is now very seldom observed in the crews of the well-manned and well-provided steamers which make short voyages between the East Indies and English ports. In enfeebled and aged subjects of arterial degeneration, as also in the younger subjects of *gangrène symétrique*, the application of but a moderate degree of cold may cause destructive changes in toes or fingers. Occasionally with the action of cold is associated that of compression of the chilled extremity, as in the not infrequent occurrence of gangrene of the toes in a patient who, after prolonged exposure to cold and wet, had fallen asleep without removing his boots. A dry and still air, however cold, is less likely to cause frost-bite than cold associated with wind and moisture.

In *treating* frost-bite of that grade in which the skin is of a deep red or a livid tint and has not yet become black and gangrenous, the medical attendant should apply warmth very gradually, and trust at first to prolonged friction with snow or sponges dipped in iced water. As the skin becomes warmer and less congested, the frozen part should be enclosed in dry flannel or cotton wool. Often, after a frost-bitten part has been found quite cold and livid and apparently dead, the whole or much of this threatened organ has been saved through great care having been taken in restoring warmth and in controlling the inflammatory reaction.

When a portion of a finger or toe has been destroyed by frost-bite, it is advisable to allow the gangrenous part to come away by itself, or, at the most, to interfere only when it is retained by ligament or bone. In gangrene of a larger portion of an extremity, as of more or less of the foot for instance, it becomes necessary in order to prevent any septic poisoning, to remove the destroyed parts as soon as this can be done without much danger to the adjacent tissues. In most cases it will be found advisable to wait for a time and to perform a secondary amputation. The structures above the seat of gangrene remain affected for some time after the application of cold, and from the direct action of any stimulus may themselves become gangrenous. By the time that a distinct line of demarcation has formed, the sound parts beyond have very probably returned to their normal condition, and may now form sound and useful flaps. In a case of decided gangrene, from intense cold, of a considerable portion of either the lower or the upper extremity, primary amputation is indicated.

W. Johnson Smith.

FUMIGATION. *See* Calomel Vapour-bath.

FUNGOUS DISEASE OF INDIA

(*Synon.*: Madura foot; Mycetoma).—*Definition.*—An endemic disease affecting the extremities, producing disorganisation of all the tissues.

Etiology.—The disease is endemic in certain parts of India, but is not limited to any particular soil or geological formation. Hitherto it has been limited to natives, especially those who go barefoot and work in the fields; it is much more frequent in men than women, and is rare below puberty, but may occur at any age after that. In many instances the patient dates the onset from an abrasion, prick, or other slight injury, but it is often impossible to trace it to any cause, either predisposing or exciting. A previous attack of guinea-worm disease, though not infrequent, can scarcely have any etiological bearing.

Varieties.—Two varieties are recognised, the pale and the black, the black being the most common; but the only difference is in the colour of the granules and the presence or absence of fungus-elements.

Pathology.—The pathology is still obscure. Vandyke Carter considers the disease to be due to a fungus, named after him Chionyphe Carteri; but since his discovery has only been confirmed in the black variety, it leaves the pale form unexplained, and the presumption therefore is that the disease is not due to the presence of the fungus; at the same time, no other theory offers any semblance of plausibility. When a section is made of a diseased foot it is often difficult to make out the various tissues, on account of the fatty and fibrous degeneration they have undergone, many even of the bones having disappeared and been replaced by fibrous tissue; the muscles are the least affected, and the fat is often much increased, but may contain black or coloured granules. The foot is perforated by sinuses in all directions, which pierce even the bones as if they had been drilled, often with no surrounding degeneration of the bone-substance; the sinuses lead into small spherical cavities, single or multiple, containing an abundance of granules, which stud the walls of the sinuses and lie free in their lumen.

The granules consist of altered fat, with a central caseous mass, surrounded by fatty crystals, while the black granules are made up chiefly of the mineral constituents of the tissues, with black pigment derived from the blood-colouring matter, and an abundance of the fungus alluded to.

Symptoms.—The tumour is single, and in the vast majority of cases affects the foot or leg, sometimes the hand or arm, and in rare instances the shoulder or scrotum. In a well-marked case the foot is enormously swollen and distorted, from the bones of the foot giving way, so that the arch is destroyed and the toes are over-extended. On various parts of the surface are pea-sized projections, and the centre of each is the orifice of a sinus leading into a cavity, which may be either superficial or deep. From these sinuses issues a sero-purulent discharge, containing the granules compared to fish-roe, which are white, yellow, or black, according to whether the case is one of the pale or black form, and in rare instances the granules are pink or red; they also stud the surface of the eminence round the orifice.

The mode of commencement varies. Only a finger or toe may be attacked first; or, affecting the body of the foot, there may be very little swelling or redness and circumscribed induration; or a papule, pustule, or tubercle appears, which may be superficial or deep, firmer, larger, and less tender than a boil, which, when opened, discharges ordinary pus at first, and later on the characteristic granules above described. Or there may be mottled discoloration under the skin like tattoo-marks, before any wound appears. The disease progresses slowly, as a rule, and it may be six or seven years, or more, before the foot becomes thoroughly disorganised, though it may have been useless for progression for a long time.

Diagnosis.—The fully developed disease, with its enormous swelling, its limitation to an extremity, and the numerous sinuses, with the characteristic discharge of 'fish roe' granules, offers no difficulty. The cases beginning with 'gunpowder grains' under the skin are also distinctive, but those with a pustule or tubercle are very like the guinea-worm disease; and probably it might be difficult to decide until the pustule was opened, when the absence of the worm and the character of the discharge would clear up the diagnosis.

Prognosis.—The disease is slowly but steadily progressive if untreated, and the whole foot or hand becomes completely disorganised and a useless and painful encumbrance.

Treatment. — When the disease is limited, removing the toe or finger may be sufficient; or, in the early stage, when the process is superficial, scraping all the affected tissue away with a sharp spoon has effectually arrested its progress in several instances; but in more advanced cases the limb must be amputated above the disease. The operator, however, is sometimes disappointed to find the bones of the leg softened beyond the apparent limit of the morbid changes, and has, therefore, to remove more than he anticipated.

H. RADCLIFFE CROCKER

FUNGUS OF THE BRAIN. *See* BRAIN, Hernia of the.

FUNGUS OF TESTIS. *See* HERNIA TESTIS.

FURUNCULUS. *See* BOILS.

FUSIBLE CALCULUS. *See* CALCULUS, Urinary.

G

GALACTOCELE or MILK CYST.—The term galactocele has been applied to three pathological conditions, of the existence of two of which grave doubts must be entertained. The true galactocele is caused by the obstruction of a duct during lactation. The obstructed duct becomes dilated by the secretion, and a cyst is thus formed, giving rise to a fluctuating swelling which is most superficial near the nipple. The tumour appears during the first few weeks of lactation without any of the signs of inflammation. It has been known to reach an enormous size, as in the celebrated case recorded by Scarpa, in which it rested on the patient's knees when she was in a sitting position, and contained ten pints of pure milk. Galactocele is undoubtedly very rare.

Velpeau describes a form of 'galactocele,' in which the milk was distending the meshes of the connective tissue of the breast, but the evidence he gives in support of the existence of such a condition is not sufficient.

The third form of galactocele which has been described, is that in which the contents have become converted into a material like cheese. Most, if not all of these cases, have probably been chronic abscesses.

Treatment.—A true galactocele is best treated by repeated aspiration, if the cyst be large, to diminish its bulk, after which it may be punctured, and a drainage-tube inserted. It may be necessary to wean the child and arrest the secretion of milk, to effect a cure. Marcus Beck.

GALACTORRHŒA. *See* Breast, Diseases of the.

GALL-BLADDER, Obstruction of the. *See* Cholecystotomy.

GALL-STONE, Extraction of. *See* Cholecystotomy.

GALVANIC CAUTERY. *See* Cautery.

GALVANO - PUNCTURE. *See* Electrolysis.

GANGLION is the name given to a limited collection of fluid which is found in connection with the sheaths of tendons, and is most commonly situated on the back of the wrist, and therefore in relation to one of the extensors of the thumb or of the fingers. It is as common in youth as in adult age, and its causation is not very definite. In some cases it may be ascribed to excessive use of the fingers, as in wringing or in piano-playing, but as often as not its origin is spontaneous. When situated on the dorsal surface it forms an even, globular swelling, fluctuating, not painful, but causing some weakness in the muscles with which it is connected. But when placed on the anterior aspect, the shape is not so distinct, and care must be taken to distinguish it from one of those protrusions of the synovial membrane of the wrist-joint which are sometimes found, and are situated usually beneath the radial artery. Another origin to which the existence of ganglia has been traced is the protrusion, through a rupture of the sheath, of some portion of the synovial sac, which, if healing of the rupture take place, is shut off, and its connection with the parent sac becomes obliterated. In most instances the contents are a clear transparent white or yellow homogeneous jelly; but when the effusion is large, there are frequently found numerous small round or oval bodies, resembling melon-seeds, which consist of a collection of fibrine, and have no organisation. Their presence before evacuation can be ascertained by a crepitation on movement of the part, which is almost unmistakable. They originate from small depositions of fibrine on the inner surface of the sac, which become rolled off by the constant movements of the tendon.

The compound palmar ganglion is a much larger collection of the same materials, which forms in the sheath of the flexor tendons, and passes beneath the annular ligament, above and below which the contents can be made to fluctuate. This sometimes attains a very large size, and may arise gradually from over-work, or from a sudden exertion, as in the case of an attendant struggling with a violent lunatic.

Diagnosis.—These chronic swellings need to be distinguished from the acute inflammation of the synovial sheaths—tenosynovitis—which occurs after such violent exertion as rowing, &c., and are evidenced by their acuteness and by the ordinary symptoms of inflammation. From disease of the wrist they must be distinguished by their situation, shape, and by the absence of other symptoms of disease of the joint.

When small and on the back of the wrist, a ganglion can often be ruptured by pressure of the surgeon's thumb, or by a smart blow from a broad instrument, and the contents are then poured out into the surrounding tissue. But if it resist this, the fluid should be evacuated by a fine trocar or grooved needle, or a sharp-pointed tenotome, and the puncture sealed with collodion. In case any return of the collection is threatened, a blister may be applied, or an absorbent ointment, containing Ung. hyd. ʒj., Ung. pot. iod. ʒj. to Ung. simpl. ℥j., may be frequently rubbed over the part until the skin is reddened. When, however, the collection is large, or when the existence of melon-seed bodies can be ascertained, an incision should be made under antiseptic precautions, and the contents evacuated completely, after which pressure by strapping must be applied and rest of the part maintained. Sometimes after the sac has been incised it may be necessary to scrape off any collections adhering to the walls, and to keep the opening patent by a drainage-tube or a wisp of horsehair.

John H. Morgan.

GANGRENE is a term employed to denote the death of a part of the living body. It implies the destruction of a considerable portion of tissue *en masse*, in contradistinction to ulceration, where, although there may be as great a destruction of tissue, the part is destroyed slowly by molecular disintegration, and there is no palpable mass of dead material, the portion destroyed being thrown off in minute particles in the form of discharge. The mass of dead matter which is the result of the process of gangrene is termed a *slough.*

Causes.—The immediate cause of gangrene, in almost every instance, is the arrest of the flow of blood in the part, but the causes which may give rise to this arrest are very numerous. It may be due to injury, or arise from constitutional causes, or from the two in combination, or it may be occasioned by specific influences. These various causes may be tabulated in the following order:—

Local Causes.—1. Mechanical injuries. 2. Chemical injuries. 3. Heat and cold. 4. Local poisons. 5. Arrest of circulation. 6. Intense inflammation. 7. Pressure or tension.

Constitutional.—1. Deficient blood-supply. 2. Impaired nutrition. 3. Loss of nervous power. 4. Spontaneous. 5. In diabetes. 6. From ergot.

Specific.—1. Carbuncle and boil. 2. Noma and cancrum oris. 3. Malignant pustule. 4. Glanders. 5. Spreading traumatic gangrene. 6. Hospital gangrene.

Local Causes of Gangrene.

1. *Mechanical injuries* are frequent causes of gangrene, the injury being of such a nature as to destroy the vitality of the tissue, so that its functions can no longer be carried on; hence the part dies and separates as a slough. This process may be seen daily, in a minor degree, in contused and lacerated wounds. The blow which produced the wound kills a thin layer of tissue, which must separate as a slough before the wound can heal. Occasionally the violence done to the part is so great that it kills its whole substance, as, for instance, in the case of the wheel of a heavy waggon passing over a limb; here the tissues are so destroyed that all circulation immediately ceases, and the part speedily falls into a condition of gangrene. At other times the injury may not be so great as to kill the tissue outright, but the vitality is so impaired that the inflammation necessary for recovery terminates in gangrene. But whether the gangrene occurs in the one way or the other, the immediate cause of it is the arrest of the circulation in the part.

When a part has been severely contused and is about to fall into gangrene, it is generally of a dark purplish colour, cold to the touch, and devoid of sensibility. The symptoms, in a great measure, will depend upon the amount of blood which has been extravasated into the tissues. When this has been poured out in large quantities the part is swollen, black or purplish-black, and soft and boggy to the feel. The temperature falls, the limb becoming cold and insensible. Bullæ, filled with blood-stained serum, form on the surface, and the part rapidly falls into a condition of decomposition. Emphysematous crackling may be felt, from the evolution of gases, and a fetid, stinking odour is perceptible.

2. *Chemical agencies* also cause gangrene in the same way, by destroying the tissue so that the blood can no longer circulate through it. This they do either by combining with the animal matter, so as to form a new compound; or else by causing the elements of the animal tissue to enter into new combinations, and thus destroying the life of the part. A familiar example of this is the common issue, where the desiccating action of the potassa fusa destroys the tissues with which it is brought into contact.

Where the gangrene is produced by the application of a caustic, the process partakes more of the dry form. In fact, the gangrene produced in forming an issue forms a typical example of 'dry gangrene,' in which the process can be well studied; the desiccating action of the potassa fusa drying up the fluids in the part, and thus destroying the tissues with which it is brought in contact. If an issue be examined a day or two after its formation, the dead tissue will be found to be quite black and somewhat shrunken, so that the cavity in which it is contained appears to be somewhat cup-shaped, and there is no discharge and no fetor. Shortly after, a halo of redness appears in the natural skin around, and the slough begins to separate.

3. *Heat and cold* produce gangrene, the amount varying with the intensity and the duration of the application. It may merely involve the cuticle, or it may destroy the whole limb; but the principle is the same—gangrene is produced in the one case as much as the other. Gangrene from frostbite may occur either from the direct effect of the suspended circulation, or from inflammation which subsequently ensues after the circulation has been re-established. *See* Burns; Frost-Bite.

4. *Local poisons*, as the extravasation of urine or fæces, may lead to gangrene. A familiar example of this is seen in cases of ruptured urethra from stricture, where the concentrated and putrefying fluid is effused into the cellular tissue in the neighbourhood, producing death of this tissue and, secondarily, of the skin from deficient supply of blood, owing to the circulation through the cellular tissue being arrested.

The skin, at first of a dusky-red hue, speedily becomes purple, and gangrenous spots appear. These give way and large masses of pultaceous, sloughing material are separated, accompanied by quantities of foul-smelling discharge. In these cases there is always great general depression; the patient is delirious, with exceedingly feeble pulse and dry, brown tongue, and often sinks from exhaustion.

5. *Arrest of circulation.*—As has been already stated the immediate cause of gangrene, in almost all cases, is the arrest of the flow of blood in a part and the stoppage of the supply of nutritious fluids, and this is due to the suspended circulation in the capillaries, as in the causes already, and still to be, enumerated. Under the heading 'arrest of circulation' are included those cases in which this suspension of circulation in the capillaries is produced by an arrest of supply of arterial blood to a part, or the obstruction of the circulation through, or retardation of the flow of venous blood from, a part. For obstruction of a main artery can only be the cause of gangrene when the collateral circulation is impossible, and therefore the capillary circulation is suspended; and in order that gangrene may result from venous obstruction it is necessary that complete stasis in the capillaries should exist as the result of complete plugging of the veins returning blood from a limb. Thus ligature or obliteration of an artery is not necessarily followed by gangrene, nor will it occur so long as the capillary circulation can be maintained. Nor will obstruction of a single vein cause gangrene, because there is in almost all parts of the body a double channel of superficial and deep veins, which freely intercommunicate, so that if one channel become closed, the other will probably be, at all events partially, open. Under certain circumstances, however, arrest of the circulation through the arteries or veins will produce arrest of the capillary circulation in a part, and then nutrition will cease, and gangrene be the result. Complete arrest of the circulation both from and to a part would of necessity cause capillary stasis, and would result in gangrene. A ligature tied tightly around a limb would produce gangrene in this way; the mortification of a strangulated hernia would depend upon the same cause. The arrest in the supply of arterial blood to a part may be produced by obliteration of the artery by accident, by ligature, by embolism, or by calcification. The return of the venous blood may be retarded or obstructed by inflammation, by thrombosis, or by pressure on the venous tract.

In the cases in which the primary cause of the gangrene is venous obstruction, the limb swells and becomes œdematous, and vesications form on its surface. The skin, at first deeply congested, speedily becomes purplish and then black. The discoloration, commencing at the point furthest from the centre of circulation, extends up the limb. The discoloured parts become cold and insensible, and gas is evolved from the decomposing tissues, which eventually become converted into a deliquescent putrid mass.

When the gangrene occurs from a thrombus or embolus, it is of the dry kind. This condition not infrequently occurs in cases where vegetations on the cardiac valves, the result of endocarditis, are washed into the arteries, and become arrested when the calibre of the vessel is no longer sufficiently large to permit their onward progress. Its advent is generally sudden and it affects one limb. The patient is suddenly seized with severe pain in the course of an artery, where it diminishes in calibre either by bifurcating or by giving off a large branch. This is followed by numbness and weight in the limb. The part 'feels dead.' It is sensibly colder than the rest of the body, and has a shrunken and white, waxy appearance. No pulsation can be felt in the arteries below the seat of obstruction. At first the boundary line between the dead and living tissues is not clearly defined, but in the course of a day or two becomes more marked, and can be exactly differentiated. The changes take place slowly, the white and waxy skin gradually assumes an olive-green tint, and then becomes black, the blackness, for the most part, appearing in patches which gradually spread. The discoloured tissues shrivel and contract, and the skin becomes hard and horny. There is little or no fetor. At the line of junction of the dead and living parts a halo of redness may now be observed, and the gradual formation of an ulcerating furrow. Later on the soft dead parts may be seen falling away from the living, the tendons resisting the disintegrating process the longest. In this form of gangrene the process is essentially chronic, and is attended by much less constitutional disturbance than in the acuter forms of the disease. In fact, the temperature may remain normal and the pulse good in these cases during the earlier stages of the disease. The formation of the line of demarcation is, however, generally attended with a slight rise of temperature and access of febrile symptoms.

6. *The intensity of the inflammation* of a part may lead to gangrene—that is to say, the inflammatory disturbance of the nutrition of a tissue is sometimes so great as to lead directly to the arrest of tissue-change, and this in its turn leads to cessation of the capillary circulation, and thus gangrene is established. In these cases it is therefore not correct to say that the gangrene is the result of capillary stasis, since, in all probability, death is established before the circulation in the part is arrested, the stoppage of the circulation being the result, and not the cause, of the death of the tissue.

7. *Pressure and tension* will produce gangrene. A practical example of the former is to be seen in a bedsore, brought on by continued pressure in a sick person. Not that all bedsores are produced by pressure; they may be produced partly by loss of nervous influence, or from a maceration of the skin from long-continued lying in a bed wetted with urine or other fluids. The true gangrenous bedsore produced by pressure occurs in debilitated and emaciated patients, who are prevented by weakness from shifting their position, and thus continuous obstruction to the capillary circulation is maintained, and the passage of blood through the parts where the pressure is great becomes mechanically difficult or impossible. Stagnation occurs, and death of the tissues takes place. The blood-vessels in the neighbouring parts become engorged, and the slough, acting as a foreign body, sets up inflammation in them, a gradual process of separation taking place, and the dead tissue is thrown off, leaving an ulcerating surface which only very tardily cicatrises, should the patient survive.

Too great tension of the tissues, leading to a deficient blood-supply, is not an uncommon cause of gangrene. Thus, in cases of phlegmonous erysipelas and diffuse cellulitis, the tension of the cellular tissue leads to deficient blood-supply to the skin, with loss of nutrition, followed by coagulation in the capillaries and consequent gangrene.

There is in these cases great swelling from the effusion into the subcutaneous tissue, and the skin becomes so hard and tense that no pitting on pressure can be produced. The redness is of a dusky hue, and is not uniform, being darker at the centre than towards the circumference. Pain is great and of a burning character. The general symptoms are severe, and often marked by paroxysms and remissions. The pulse is quickened and oftentimes irregular and intermittent; the tongue thickly coated, with a yellow, creamy fur; the urine high-coloured and loaded, and its quantity much diminished.

Constitutional Causes.— One of the most frequent constitutional or general causes of gangrene is (1) *deficient blood-supply* to a part, arising either from disease of the arteries or of the heart, or probably more frequently from the two combined. It is met with usually in the lower extremities of persons of advanced life, and the disease is the result usually of systemic decay. When it arises from this cause it is distinguished by the generic term 'senile gangrene.' In advanced life the arteries become rigid and calcified, and lose their power of adapting themselves to suit the various exigencies necessary for nutrition; this in itself is not sufficient probably to produce the gangrene, but when combined with diminished propulsive power of the heart, so that the circulation, especially in the lower extremities, is weakened, arrest of the flow of blood takes place, and gangrene inevitably follows. It appears, however, that the immediate cause of the arrest is sometimes a slight injury, such as an abrasion or some such trivial lesion, which is the starting-point of the disease. It seems as if the tissues were just sufficiently nourished to maintain their vitality, and that the slight injury destroys the balance of the circulation, and, as a result, gangrene ensues.

The disease is usually ushered in by the appearance of a dark red or purplish spot at the seat of the injury, or on one of the toes, generally the inner side of the great toe. This is surrounded by an areola of dusky red tissue, and is accompanied by a smarting and burning pain of a paroxysmal character. The gangrene advances by involving the inflamed areola, and as the whole toe becomes involved, it shrinks and becomes smaller. In this way the disease extends, gradually invading one toe after another, until it implicates the foot, and unless arrest takes place and a line of demarcation is set up, it may extend up the ankle and leg. Frequently, however, if the patient should survive, the gangrene becomes arrested in the neighbourhood of the ankle-joint, at about the situation of the division of the posterior tibial vessels, and a tolerably clearly defined line is formed between the living and dead tissues. Here a process of ulceration may be set up, and the parts which have perished gradually separate from the living tissues. Or it may happen that after an apparent line of demarcation has been established, a fresh impulse appears to be given to the mortification, and it again rapidly extends and involves the whole limb. There is generally considerable constitutional disturbance: fever of a low asthenic or irritative type, with depression of the vital powers, and low, muttering delirium; and the disease frequently terminates fatally in a month or six weeks.

2. *From impaired nutrition.*—Under this head is included gangrene occurring in the course of certain severe diseases, especially the exanthemata, which have long been known to produce this result. There seems to be good ground for believing that in some of these cases, at all events, the gangrene is the result of a debilitated condition of the system, consequent on a long illness. The heart in these cases being especially enfeebled is unable to drive the blood, which itself is impoverished and deficient in nutrition to the distant parts of the body, and gangrene is the result, from coagulation of the blood in the capillary vessels. It may be that, in some of these cases of gangrene following the exanthemata, embolism is the immediate cause of the complication. According to Estlander, this is the cause in cases of gangrene after typhus fever, miasmatic thrombi forming in the left side of the heart, and being carried thence into the vessels of the extremities.

3. *Loss of nerve-power.*—There can be little doubt that loss of nerve-power is a cause of gangrene, and that parts deprived of their proper nerve-stimulus may fall into a condition of mortification. A familiar example is presented in sloughing of the cornea, resulting from injury of the fifth pair of nerves, which destroys the nervous sensibility of the part and impairs its nutrition. Two explanations of this phenomena are usually given. One is that this impairment of nutrition depends on some altered state of the vaso-motor nerves, producing, probably, a paralysis of the muscular coat of the blood-vessels and a permanent dilatation; the other, that the change is brought about by irritation of certain special or 'trophic' nerves. It must be borne in mind that even the existence of these trophic nerves is purely hypothetical, and that, if they exist, nothing certain, as to the course they run or the centres they own, is known about them; whereas it is an acknowledged fact that elevation of temperature, the result of hyperæmia from vaso-motor paralysis, is a common sequel of loss of nerve-power, and, according to Professor Schiff, changes in nutrition occur in parts which are the subjects of vaso-motor paralysis.

Mr. Hutchinson has advanced a third theory as to the cause of gangrene as a result of nerve-lesion. He believes that it is due to a condition of spasm of the muscular coat of the blood-vessels, brought about by reflex irritation of a sensory nerve. He quotes, as an example, a case related by Mr. Hilton, where an exostosis on the first rib, pressing on the ulnar nerve, produced gangrene of the little and adjacent side of the ring finger, and states his opinion that the pressure on the ulnar (sensory) nerve was conveyed to the spinal cord, and reflected along the vaso-motor nerves which run in the ulnar nerve itself to the blood-vessels of these two fingers. Mr. Hutchinson also suspects that ordinary senile gangrene begins from defective nerve-supply.

4. *Spontaneous gangrene* is a peculiar form of gangrene affecting the extremities,

which Raynaud first described under the name of 'La gangrène symétrique des extrémités.' As the name implies, the gangrene comes on symmetrically in the two extremities. In a case recorded by Dr. Begg, of Dundee, it attacked both upper and lower limbs. The exact cause of this form of gangrene is unknown, for pathological examination has revealed neither embolism nor blocking of the vessels, nor degeneration of their coats. It occurs for the most part in weakly and anæmic individuals, with extremely feeble circulation, who habitually suffer from cold extremities, and appears to arise from a contracted condition of the capillaries, so that little blood circulates in them, conjoined with a weak action of the heart, so that its propulsive power is reduced to a minimum. *See* ARTERIES, Diseases of.

5. *Gangrene in diabetes.*—Patients suffering from the presence of sugar in their urine appear to be especially liable to be attacked by gangrene, which may come on either spontaneously or follow some slight operation. It appears to commence as an inflammatory process, to which patients suffering from diabetes are peculiarly liable, and which would seem to arise from the diseased condition of the blood, and passes on into gangrene, accompanied by considerable inflammatory action.

Like senile gangrene, it may commence apparently as the result of a slight injury, or may occur spontaneously, appearing as a black spot, generally on the side of the toe, which spreads rapidly, and is accompanied by a considerable amount of inflammation in the tissues around, and often by acute pain.

6. *From ergot of rye.*—The gangrene due to ergotism is supposed to be due to a continuous spasmodic contraction of the muscular coats of the smaller arteries, thus narrowing the calibre of the vessels and diminishing the supply of blood to the part. The disease is almost unknown in modern times, and appears to have been more common in France than in this country.

The disease appears to have presented itself under various forms and types, partaking more of the character of dry gangrene, and rarely presenting the moist variety. It usually commences with itching and tingling of the hands or feet, and cramp coming on from time to time in the muscles of the limbs affected. After a time these abnormal sensations are succeeded by numbness, passing into complete loss of sensation. The fingers or toes, as the case may be, become shrivelled, dry, black, and mummified, and the gangrene gradually extends, and may involve the whole extremity. When the disease is chronic the result is generally favourable, though several fingers or toes, or even a whole limb, may be lost; but in the more acute cases death generally results within the course of a week or ten days.

SPECIFIC GANGRENE.—Under this heading are classed together those cases of gangrene where the disease is believed to arise from some special condition of the blood, or to be due to some miasmatic influence. Such are cases of *noma pudendi* and *cancrum oris*, which are probably due to some specific poison, occurring in the children of the poor, who have been exposed to faulty hygienic and dietetic conditions, and particularly if the child has been previously ill; but occasionally occurring in perfectly healthy children, who have had no previous illness. Such, also, are cases of *boils* and *carbuncles*, where there is gangrene of the subcutaneous cellular tissue following inflammation, set up by some abnormal constituent in the blood. *Malignant pustule* or *charbon*, and *glanders* are also forms of gangrene where the disease is caused by the introduction of a specific morbid poison.

The true *spreading traumatic* gangrene is believed also to be due to the presence of septic organisms, causing a diffuse inflammation extending along the cellular planes or up the course of the veins or absorbents, and rapidly running into gangrene. This unhealthy spreading inflammation is predisposed to by certain diseased conditions or impure states of the blood, arising more especially from disease of the eliminatory organs, particularly the kidneys, or from chronic alcoholism. It seems that in these vitiated constitutions the tissues furnish a soil peculiarly favourable to the growth of organisms which give rise to inflammatory processes.

It occurs only in recent wounds, before suppuration is established, and for the most part manifests itself within three or, at the most, four days after the receipt of the injury. The edges of the wound become swollen and everted, and present a waxy appearance, with vesications along their margins. There is a slight discharge of fetid, brownish-coloured serum, but no suppuration. At this time there is but very little constitutional disturbance, but within twenty-four hours, swelling, tension, and redness appear around the wound, and rapidly spread upwards, especially along the inner side of the limb. The discoloration, at first red, soon becomes of a dusky, purplish hue, and speedily passes into black. The swelling, primarily firm and resisting, becomes soft and doughy, and presents to the fingers the sensation of emphysematous crackling, due to the evolution of gases which are produced by the decomposition of the affected part—the putrefactive process immediately following the death of the tissues. The disease spreads with fearful rapidity, being preceded by swelling and dusky redness of the skin, which speedily becomes purplish-black, and passes on into a condition of hopeless gangrene in the course of a few hours. The disease extends along the cellular planes until it reaches the trunk, when it terminates in death. It differs from other forms of gangrene in presenting no tendency to arrest, or the formation of a line of demarcation.

The constitutional symptoms which rapidly supervene after the commencement of the disease are of the lowest ataxic type. The pulse, at first full and strong, soon becomes rapid and feeble, and after a time irregular and intermittent. The temperature is raised considerably above normal. The skin becomes yellowish and the countenance contracted and sunken, the face presenting a peculiar leaden hue. There is often constant vomiting, accompanied by hiccough, and the tongue is dry and brown. The abdomen becomes tympanitic, and there is a sensation of constriction around the præcordium. A deep-seated, tensive, burning pain is complained of in the limb. Soon muttering delirium, with jactitation of the limbs, comes on, followed by coma, and death almost invariably ensues in three or four days after the invasion of the disease.

Hospital Gangrene is due to a specific cause, the introduction by inoculation into the system of a contagious material, which by its presence is the cause of the progressive destruction of the tissue.

All these forms of gangrene due to a specific septic cause will be considered under separate headings, to which the reader is referred.

Pathology.—In considering the causes of gangrene, it has been stated that almost all forms commence by a stasis or arrest of circulation in the capillaries. The only instance in which this is not the case is, when the inflammation is so intense that it leads to the arrest of tissue-change even before the circulation in the capillaries has completely ceased. This, however, soon follows, as the result of the alteration in the nutrition of the coats of the vessel from cellular infiltration; so that, sooner or later, in a part which is becoming, or has become, gangrenous, there is complete stagnation in the capillary vessels, and arrest of the supply of nutritious fluids. The part therefore, of necessity, dies, is no longer capable of taking part in the functions of the living body, and becomes a foreign substance to which two things must happen. First, being no longer living, it must undergo a series of chemical changes, which result in decomposition; and secondly, being a foreign body and no longer capable of ministering to the necessities of the individual, it must be cast off and separated from the living tissues, thus forming what is termed 'a slough.' The death of a part is not always followed by the same series of changes. These will depend upon the presence of oxygen, and the amount of water in the tissues. For in the first place if oxygen be absent from the part, as in splenic infarction (which is a form of gangrene), no putrefaction can take place; and secondly, when the tissues are much engorged, at the time of death, with blood and serum—when, in other words, there is the presence of water in large quantities—the moist form of gangrene will be the result, with rapid decomposition. When, on the other hand, the quantity of fluid, that is, water, in the tissues is small, the dry form of gangrene occurs, and the part undergoes a process of mummification, the difference existing rather in the clinical characters than in the anatomical changes. The putrefactive change consists in a solution of all the solids of the body, with the exception of the bones, in the fluids, because, in consequence of their death, they are no longer able to withstand the solvent power of such fluids. It is therefore a solution of the constituent elements of the body in water, and consists chemically in the decomposition of the various constituents of the body, and the recomposition of new products formed out of the elements with the addition of the oxygen of the atmosphere.

The gangrenous part, being dead and undergoing decomposition, becomes injurious to the living tissues, and must be cast off and separated from them. This is done by a process of ulceration, or molecular disintegration, in the living tissues which are in contact with the dead. The process of ulceration is a vital process, and can only be carried on in living tissues. Accordingly we find the vessels in the tissue forming the extreme boundary of the living part becoming enlarged and gorged with blood; migration of cells with proliferation takes place, so that the part is crowded with a dense layer of leucocytes. From these is formed a layer of granulation-tissue, by the growth of new vessels. The surface of these granulations—that is to say, the surface in contact with the dead tissue—softens and breaks down, the cells becoming converted into pus-cells, and thus the dead portion naturally falls off, because its adhesion to the living tissues has ceased to exist. This border line between the living and dead tissues, in which the process of separation of the one from the other takes place, is called 'the line of demarcation.'

After the dead parts are separated from the living, the surface of the latter is seen to be covered over with a layer of granulations, which eventually cicatrise and become converted into fibrous tissue.

Symptoms.—The symptoms of gangrene naturally form two great divisions, the one where the parts are swollen and moist —the so-called *moist gangrene*; and the other where they are dry and shrivelled— the *dry gangrene.* This division is a classical and, in extreme cases, a well-marked one, but, under ordinary circumstances, it is not easy to refer a case to one or the other class; the form of gangrene being often midway between the two extremes. Or, in a given case, we may have a gangrene partaking of the dry form in one part and the moist form in another. Thus in a case of mortification of the leg, it is not uncommon to find the toes and dorsum of the foot presenting the characteristic appearances of the dry or mummified form, while the calf of the leg, where the tissues are thicker, presents the typical characters of the moist variety of the disease.

Moist Gangrene may be best studied in a part which has been sufficiently strangulated to arrest the return of blood from the tissues. If the strangulation is more severe than this, so as to stop the flow of blood both from and to a part, as in the ligature of a pile or nævus, it kills the tissues outright. But if it is less severe, it prevents the flow of blood from the part, at the same time that it permits the entrance of blood to the part, the veins being more affected by the constricting force than the arteries. In consequence of this we get, first, a condition of intense congestion; blood continues to be propelled into the capillaries, from which it cannot escape. Hence, as the vessels become more and more loaded, the inflowing stream becomes slower and slower, until it eventually stops, the part being so overcharged with blood that no more can enter. This constitutes the second stage, for when complete stasis takes place gangrene is established. The third stage consists in decomposition, for after the gangrene has set in, decomposition commences, as has already been stated.

A line of demarcation is then established, and the mortified parts begin to separate at this point.

In considering the *symptoms* it is useful to divide them into three stages. *First stage*, congestion. The part becomes swollen, the swelling being at first hard and brawny, but after a short time pulpy and œdematous, as transudation through the coats of the vessels takes place. The colour, at first red, speedily becomes dusky and purplish and then almost black. There is a dull heavy burning pain in the part, with exalted sensibility, and the temperature is raised above its normal standard. Phlyctenulæ or vesicles arise on the surface, and become filled with a dark bloody fluid. *Second stage.* So soon as complete stasis takes place, the temperature begins to fall, and the thermometer soon registers a degree considerably below that of the rest of the body, and on a level with that of the surrounding media. Pain in the part ceases and it loses all its sensibility, so that the prick of a needle can no longer be felt. It changes its colour, becoming of a mottled greenish-black or purplish hue. *Third stage.* Decomposition now sets in, the part becomes very soft and boggy, and gives to the finger a sensation of emphysematous crackling, due to the evolution of gases in the tissues; a peculiar odour is also evolved from the formation of certain volatile compounds, such as sulphuretted hydrogen, ammonia, and hydro-sulphate of ammonia. At the same time a line of demarcation is established. At the point where the living join the dead tissues, a bright red band may be seen, gradually losing itself in the natural skin. This halo of redness is very different, and easily to be distinguished, by its brightness, from the dark and purplish hue of the gangrenous tissue. There is also generally some swelling. Shortly after a careful examination will reveal a slight furrow at the extreme margin of this inflamed tissue. The furrow deepens day by day, and increases somewhat in width, gradually undermining and separating the dead from the living tissues, the process being accompanied by a copious secretion of pus. The line of demarcation does not present a regular circular appearance, but a zigzag irregular outline, in consequence of the unequal distribution of the vessels. If a whole limb be mortified and cast off, the superficial tissues are separated at a much higher level than the deeper ones, and therefore the stump after this natural amputation presents a very conical form, from the centre of which the bone, which is only separated by an exceedingly slow process, protrudes.

Dry Gangrene occurs when the whole supply of blood is entirely cut off and the part perishes from want of nutrition. It is best studied in those forms of gangrene in which the supply of blood to a limb is suddenly cut off by the blocking of the main artery by an embolus. In these cases there is a rapid cutting off of the arterial supply. The blood in the limb finds its way out by the veins which are unaffected, and hence there is less blood than natural in the part. Accordingly the part presents a shrunken or shrivelled appearance, and assumes a dull, tallowy-white colour, mottled here and there with brownish or greyish streaks. No pulsation in the vessels can be detected. The part feels dead and heavy, and at once entirely loses its sensibility. It feels cold to the touch and its temperature speedily falls, until it reaches that of the surrounding media. Very shortly the pale colour becomes lost, and the part becomes first brown and then black; it presents a more and more shrivelled appearance, and gradually dries up, as it were, so as to present the appearance of a mummy, and hence the name 'mummification,' which has been applied to this condition. The line of demarcation is set up and the process of separation continued as in the other variety.

The *constitutional symptoms* vary according to circumstances. When the constitution is sound and the gangrene is the result of some injury, the fever is of the ordinary inflammatory type, being characterised by a hot and dry skin, with a rise in the temperature of from 2° to 4° F., a full and quickened pulse, and a white and creamy fur on the tongue. But even in these cases there is a great tendency to asthenia, with depression of the powers of the system. If, on the other hand, the constitution is unsound, the symptoms are of an asthenic type from the first; a hot and burning skin, a considerable rise in the temperature, a feeble, very quick, and easily compressible pulse; a dry, furred tongue, with sordes; great depression of the nervous system, with anxiety of countenance and low, muttering delirium. The amount of constitutional disturbance in gangrene varies also with the situation and extent of the disease. If it affects a part which is of no great importance, as a finger or toe, and is limited in extent, and perhaps due to a local cause, the accompanying fever is very slight. When, on the other hand, it implicates an important organ or structure, as, for instance, a knuckle of intestine, the symptoms assume a grave and rapidly adynamic type.

Treatment.—As gangrene arises from numerous causes, it is clear that no one plan of treatment can be universally adopted. It will be convenient, nevertheless, to consider first the broad indications for treatment, and then pass in review the various modifications in our therapeutical and operative measures which will have to be resorted to, in reference, not only to the cause of the disease, but also to the constitutional condition of the patient.

The first point in the treatment of gangrene, and one of the highest importance, is, if possible, to remove the cause, and so arrest the gangrene. In some cases this, of course, cannot be done; but in others, where it is caused by the mechanical obstruction to the circulation of the blood in the part, the first thing the surgeon has to do is to get rid of this obstruction. Thus, gangrene, when threatening as a result of inflammatory processes producing tension, may often be averted by timely and free incisions into the inflamed and swollen tissues. So again, in hernia, by division of the stricture; in parts which have been too tightly bandaged, by the removal of the bandages; in paraphimosis, by freeing the prepuce; and in other cases, the surgeon may prevent a gangrene from supervening, and recovery may take place by restoring the circulation of the part, if the disease has not progressed so far as to have irreparably destroyed the tissues. In all cases where gangrene is imminent, an endeavour should be made, by maintaining the vital warmth of the part and encouraging and relieving the embarrassed circulation, to prevent its occurrence. This is best done by swathing the whole limb in a thick layer of medicated cotton-wool and applying loosely a flannel bandage. Hot water bottles may be placed in the bed, but not in contact with the part. The limb should be raised and the joints flexed; thus, in the lower extremity, the thigh should be bent slightly on the abdomen and the leg on the thigh, a position which will best facilitate the flow of blood through the larger vessels. If there is any appearance of venous congestion, the return of blood through the superficial veins may be accelerated by continuous and methodical friction in the course of the circulation, which will tend to keep these veins empty. Poultices, which are often employed in these cases, should be avoided. The endeavour of the surgeon should be to maintain an equable temperature; whereas the tendency of a poultice would be to produce a directly opposite effect, when first applied raising the part above the normal temperature, and subsequently, on cooling, depressing it below the ordinary heat of the body. After the gangrene is fully established and a line of demarcation set up, poultices—and especially charcoal poultices—are often extremely useful in hastening the separation of the dead parts.

After the gangrene has become fully established, our aim must be to control, as far as possible, the spread of the disease; to encourage the rapid separation of the sloughs; to support the powers of the patient, and to keep the parts as clean and free from odour as possible. At this time the question of amputation will present itself to the surgeon, and is one of vital importance. As a rule, in most cases it is safer to await the formation of a line of demarcation before undertaking the removal of a limb, but nevertheless there are exceptions to this general rule. In some forms of local gangrene, where, for instance, it is the result of some severe injury, and the whole limb has fallen into a condition of gangrene, either as the direct result of the injury or indirectly as the result of the subsequent inflammation, and the gangrene is clearly defined, it cannot be doubted that it is expedient to remove the part at once in order to relieve the patient of a great source of irritation, and of the depression of the vital powers which will of necessity ensue from the efforts made to rid the system of a spoiled part. So again, in gangrene from a ruptured artery or aneurism, amputation should at once be performed, inasmuch as the tissues are so infiltrated with blood poured out from the ruptured vessel or sac that there is no chance of the collateral circulation being carried on, or of the gangrene being arrested short of the seat of the injury. But in cases of mortification arising from ligature of an artery, or from an embolus plugging a large vessel, the proper course to pursue is to wait until a line of demarcation is set up, for it is impossible to say how much of the limb is dead or how far the gangrene may extend. Many forms of local gangrene do not require amputation at all; when it arises from a mechanical injury, and is *strictly limited* in its nature, no operative proceedings are required. So again, in the gangrene arising from the application of heat or cold, or from chemical agencies, it is better not to remove the destroyed parts, but to wait for the formation of a line of demarcation, unless, indeed, a hand or foot is completely dead, when immediate amputation may be necessary.

In gangrene arising from constitutional causes, there can be no question as to the propriety of delaying the amputation until not only a line of demarcation has been set up, but until it is well established and the ulceration has extended deeply into the tissues. In these cases it is impossible to say where the mortification may stop, and if amputation is performed it may not be done high enough, and the disease will recur in the stump; and, on the other hand, it may be done too high, and an unnecessary amount of limb be sacrificed. In these cases of constitutional gangrene, it must be borne in mind also that the tissues immediately above those which have fallen into gangrene are in a condition of greatly-diminished vitality, and therefore, if an operation be too hastily carried out, the disturbance set up by the amputation may occasion a recurrence of the mortification.

With regard to amputation after a line of demarcation is set up, there is some divergence of opinion, some surgeons preferring to allow the limb to separate of itself, others considering that its removal through, or just above, the line of separation is the preferable course. As a general rule, it would seem better to get rid of a large mass of decomposing tissue, which must create a very deleterious atmosphere, and expose the patient to the risk of purulent absorption; but to this rule there are exceptions.

If the surgeon has decided to save the limb, or if the gangrene is in some part inaccessible to operation, his endeavour must be to hasten the separation of the sloughs and diminish their fetor. This may be done by maintaining the heat of the part by wrapping the limb in cotton-wool well sprinkled with carbolate of lime, or animal charcoal powder. Poultices should not be applied if the amount of sloughing is great, since the moisture tends to promote decomposition; but if the sloughs are small, charcoal or yeast poultices may be used. The separation of the sloughs may be hastened also by the application of some of the balsams, of which the compound tincture of benzoin is the best. A most useful application for the same purpose is the 'green ointment' of the St. George's Hospital pharmacopœia :—℞. Unguenti elemi, lb. j.; Unguenti sambuci ℥ij.; Copaibæ ℥iij.

The ointments to be melted together, and, when cooling, the copaiba to be added. Ung. sambuci is made with the *fresh* leaves of the elder (lb. ij.), prepared lard (lb. ij.), and as much water as required.

The constitutional treatment consists in supporting the powers of the patient and lessening the irritability of the nervous system. It must be borne in mind that the disease in itself indicates a depressed condition of the system, and therefore the endeavour of the surgeon should be to maintain the patient's strength by easily-digested nutritious food, stimulants, and tonics, and to improve, if possible, the digestion, by clearing out the alimentary canal, so as to enable him to take the requisite amount of nourishment. The food and stimulant must, however, be given with a discriminating hand, great care being taken not to overload the patient's stomach; just so much of bland, nutritious food and stimulant as he can easily digest should be given in small quantities and frequently. In most cases the issue of a case of gangrene depends upon the digestive organs effectively and efficiently performing their duties. Should they become overworked, sickness and vomiting, with loathing and refusal of food, will come on and the patient will rapidly sink. At the same time pain should be allayed and the general system soothed by the administration of opium, or some other narcotic. There are few cases of gangrene in which a narcotic is not required, and of these opium is decidedly the best. Should it, however, cause excitement, or loathing of food, some other must be substituted, as morphia injected under the skin, or cannabis indica, which is often tolerated when opium cannot be borne.

It remains now only to say a word or two upon the treatment of some special forms of gangrene. And, first, as to the treatment of senile gangrene. Here the plan to be adopted, as far as regards the constitutional treatment, is much the same as in other forms, opium being especially indicated and usually well borne. At the same time stimulants must be given with care. A small quantity is no doubt usually necessary; but, given in large quantities, so as unduly to excite the patient and increase the action of the heart in its endeavours to drive the blood through the calcified and narrowed vessels, they do more harm than good. The main point for consideration is the question of removal of the dead parts after a line of demarcation has been set up, and this may be done either by amputation just above the line of separation, or by removing the limb high up in the thigh, a plan formerly advocated by James, of Exeter, and more recently adopted in several cases by Hutchinson. As a rule, the former operation is to be deprecated, gangrene often recurring in the stump, and secondary hæmorrhage, from the diseased condition of the vessels being of frequent occurrence. The latter operation is also a very serious alternative, and unless the general health is otherwise good and the constitution tolerably sound, appears to be scarcely justifiable. The better plan in these cases seems to be to allow the soft parts to separate by nature, and then carefully to cut through the hard parts along the line of demarcation.

The question of amputation in another form of gangrene demands attention, and that is in the spreading traumatic gangrene of inflammatory origin. In these cases there is, as has been pointed out, no tendency to the arrest of the gangrene and the formation of a line of demarcation. The morbid process rapidly extends to the trunk and speedily kills the patient. In these cases, feeble as is the chance, amputation is the only hope of saving the life of the patient, and should be adopted at once. There is no time for delay; so soon as traumatic gangrene begins to spread, amputation should at once be performed through healthy parts, and a certain proportion of cases will recover. T. Pickering Pick.

GASTRIC FISTULA.—A communication between the stomach and the external air. It necessarily implies adhesion between the peritoneal surfaces of the stomach and the anterior abdominal parietes. The object of the operation of gastrostomy is the safe production of such a fistula. But it is occasionally produced by accidental causes; for example, by gunshot wounds, where a portion of the anterior abdominal parietes and wall of the stomach have been carried away, as in the well-known case of Alexis St. Martin. Another class of cases in which these fistulæ may be produced is where the patient has swallowed hard, irritating material which cannot pass through the pylorus. Thus knives, and other iron instruments, have occasionally given rise to the formation of such a fistula. The way in which they do so is this: first such a body becomes impacted in a certain position, usually from before backwards, in the stomach. The constant pressure gives rise to some severe local peritonitis between the front wall of the stomach and the anterior abdominal wall, and the two adhere. Ulceration then supervenes from the same cause, and gradually affects the opposing thickness of stomach-wall and wall of abdomen, so that finally the foreign body presents at an abdominal wound, and may be removed at that point. The aperture so left is the gastric fistula in question.

No particular treatment is required for such a case, except to prevent leakage of the gastric juice from it. A gastric fistula may nearly always be recognised by the acid, irritating quality of the secretion flowing from it, by the absence of bile-staining, and by the kind of food escaping from it. If it should be desired to cure it, this can nearly always be done by a plastic operation—paring the edges and bringing them closely together by sutures. The same is true of a gastric fistula produced by a gastrostomy. H. G. Howse.

GASTROSTOMY.—The operation of making a fistulous opening into the stomach from the anterior abdominal parietes, for the sake of feeding a patient, when, from any cause, the natural passage down the œsophagus is obstructed. The word is derived from γαστὴρ, belly, στόμα, mouth, —the 'belly-mouth,' hence not to be confounded with gastrotomy, which is simply cutting into the abdomen for tumour or any other affection.

The operation is most frequently performed for cancerous or syphilitic strictures of the gullet, but it has been also done for simple inflammatory stricture or ulceration, as when the gullet has been nearly destroyed by the patient swallowing caustics by accident or for suicidal purposes. Up to quite recently the operation had been nearly always attended with fatal results; but, by a modification introduced by the writer of the present article a few years ago, the operation is now only attended with a very small mortality, and even this is mostly attributable to the late period at which the operation is done, and the consequent exhaustion (from starvation) of the patient. The modification alluded to consists in securing adhesion of the stomach to the abdominal walls before opening the viscus itself, this part of the operation being delayed for periods varying from three to five days.

The steps of the operation are:—(1) making an oblique incision about two and a half inches long, parallel with, and about one inch below, the lower margin of the costal cartilages forming the lower boundary of the thorax on the left side. This incision should start about one and a half inches from the median line, and its length must depend upon the varying development of the rectus muscle. It is not wise to go higher than this, as it will not leave enough free integument and muscle between the cartilages and the incision to fasten the sutures to. This first incision is only to be carried through the integuments and fascia. When made, the sheath of the rectus will be seen at its inner end, and at its outer end a portion of the linea semilunaris and of the obliquus externus muscle. The usual plan of continuing the operation is to have the muscle and fascia of the abdomen incised in the same way as the superficial parts. The writer has, however, found it more advantageous to continue the operation in the following way:—(2) The lips of the wound being separated towards the inner part as widely as possible by retractors, a *vertical* incision is made in the sheath of the rectus a little way from its outer margin. The vertical fibres of the rectus will then be seen, and these should be separated (not cut) with the handle of the scalpel, and the posterior part of the sheath exposed. This may then be incised vertically, together with the sub-peritoneal fat and peritoneum. (3) The search for the stomach will now commence. Very possibly it may protrude into the wound, but it may be altogether hidden under the ribs, or the liver may be enlarged, and be the only viscus at first visible when the peritoneal cavity is opened. If the liver presents it may be easily pushed aside, though the position of this viscus may afterwards interfere inconveniently with the adjustment of the sutures. The principal difficulty is with the great omentum and transverse colon, which may be easily confounded with the stomach. If one of these presents in the wound, it is best to catch hold of it and draw it down. In this way the stomach may be brought into view. It is recognised by its pink-red, smooth, thick coat, quite unlike that of the transverse colon.

(4) The stomach has now to be fixed to the abdominal parietes. This is usually done with a double row of sutures. For this the writer commonly uses moderately thick, smooth carbolised silk. Drawing the stomach well over to one side, a needle (in handle) carrying the silk should be passed through the serous and muscular coats of the stomach only, and should then transfix the abdominal parietes about one inch from the wound. The needle is now withdrawn, leaving one end of the silk on the surface,

and without unthreading the other end the abdominal parietes are again punctured alone. The silk is now unthreaded from the eye of the needle and the latter withdrawn. The two ends of silk will thus be left projecting from two distinct wounds on the skin close by one another, and holding up a bit of the serous and muscular coats of the stomach. These ends may ultimately be tied over a bit of bougie, the aim being to secure isolated points of attachment between the two layers of peritoneum by interrupted sutures. Before tying any one suture, it is best to introduce the others, drawing the stomach well over from the side towards which it is wished to introduce the suture. Six or eight sutures introduced in this fashion are usually used. The result is to fix the gastric peritoneum in a circle about one inch round the wound. The part of the stomach exposed in the wound should then be fixed to the lips of the incision by small wire sutures, introduced by a small curved needle held in a needle-holder, these again only taking up the serous and muscular coats of the stomach. Finally it is best to *mark* the point at which it is desired to puncture the stomach ultimately, by fixing to it a moderately long, loose suture, which may easily be recognised from the others. The operation should be conducted with Listerian precautions, and, of course, under an anæsthetic.

Five days is the usual time the writer has left the stomach in this way for complete adhesion to form. The opening of the stomach is a very minor affair, and does not require any anæsthetic. The patient never complains of pain and, in the writer's experience, generally does not even know when the puncture is actually made. A long narrow-bladed pointed knife is usually employed, such as is used for paring the edges of a vesico-vaginal fistula. The knife should be very sharp, and be driven straight into the stomach in the position of the mark left at the first operation. The cavity of the stomach often apparently lies much deeper than would be expected, and makes the operator sometimes fear he has punctured the lesser bag of the peritoneum. A small catheter (No. 7 or 8 English) should then be slid along the blade of the knife, which may be withdrawn. For ascertaining whether this is in the stomach-cavity, sucking at the tube is often a useful though not a pleasant mode of testing; but in these cases of starvation there is usually very little to draw out through the tube. Small quantities of milk and brandy may immediately be injected along the catheter, but the quantity should be very moderate at first, beginning only by teaspoonfuls, and increasing afterwards. A bit of elastic tube being adjusted over the catheter and plugged, the wound should again be dressed antiseptically, leaving the end of the tube projecting through a mass of surrounding gauze.

At subsequent dressings larger sizes of catheter may be substituted for the No. 8, and, finally, soft red rubber tubes introduced up to any convenient size. The patient should first be fed with fluid food, such as milk and beef-tea, &c. But when the larger sizes of tube have been introduced, solid food may be poured into the stomach by the aid of a large wide-mouthed syringe, This food should be minced meat with a certain proportion of vegetables, all finely ground in the mincing-machine.

Many other details must of necessity be omitted in a short article like the present; but it may be remarked, in conclusion, that the object of the vertical incision through the rectus muscle, and of the small incision, and subsequent gradual dilatation, of the stomach, is to obtain a kind of sphincter action around the tube, so as to prevent the leaking of the gastric juice, which is so unpleasant a feature in some of these cases. The vertical separation, without cutting, of the fibres of the rectus muscle, and the puncture and subsequent dilatation of the muscular coat of the stomach, conduce to this end more effectually than any other method. H. G. Howse.

GASTROTOMY. *See* Laparotomy.

GAUZE DRESSING. *See* Antiseptic Surgery.

GENU EXTRORSUM is something more than Bow-Leg (q. v.), which is simply an outward bending of the leg-bones; in genu extrorsum the thigh-bone is bowed outwards as well as the leg-bones, so that the knees are widely separated. As opposed to the inward deviation of knock-knee, genu extrorsum is sometimes spoken of as 'out-knee.' The condition is met with in heavy, weakly, or rachitic children, in whom the bones are less able to support the weight than are the ligaments. When the ligaments are the first to yield, genu valgum appears, but when the bones are feeble, genu extrorsum is induced. With the strong support of the ilio-tibial band, the external lateral ligaments of the knee-joint are competent to resist any strain that may be brought to bear upon them, whilst from the natural obliquity of the femur, the chief strain falls upon the inner side of the joint. The bending of the bones of the thigh and leg is not associated with notable alteration in the shape of the femoral condyles, as is the case in genu valgum.

Many of the remarks made in connection with the subject of Bow-Leg will apply in the treatment of genu extrorsum; but as the knee-joint is displaced to the outer side of the normal line, it would be incorrect to bandage the limb to the outer side of a long splint; the effect of this treatment would be to throw a useless strain upon the internal lateral ligament, which is in no way at fault. Indeed, in all attempts at the forcible straightening of the limb, this ligament must be respected. Though forcible straightening is of value in the treatment of these limbs in early childhood, it is as a rule unnecessary; for if the child be kept entirely off his feet, and well looked after, he will most probably outgrow his deformity. A strict and prolonged supervision gives excellent and surprising results. The expensive mechanical supports of the makers of surgical apparatus are of little service; whilst to allow a weak-boned child to walk about in 'irons' is a violation of all sound principles of practice. What is required is absolute rest in childhood; but when the bones are fully developed, as in young adults, nothing short of osteotomy can remedy the deformity. *See* Osteotomy. Edmund Owen.

GENU VALGUM or KNOCK-KNEE is a common deformity of childhood, and, unless corrected, is apt to persist in even a more marked form in adult life. To leave this disfigurement unattended to, and to promise the parents that the child will certainly 'grow out of it,' is to court disappointment. It is generally associated with, if not determined by, a relaxation of the ligaments of the ankle and sole of the foot, the knock-kneed subject being generally flat-footed. The tibia having lost much of its support at the inner ankle, the upper surface of its head receives the weight unevenly from the two femoral condyles, the outer tuberosity getting more than its due share. This extra pressure causes some arrest of growth of the external condyle of the femur, whilst under the diminished pressure the internal condyle grows inordinately; in some instances it is at the internal tuberosity of the tibia that the growth of bone takes place, in which case there will be considerable bony thickening at the inner side of the epiphysial cartilage. When growing lads are called upon to do an excessive amount of walking or standing, or when they follow employments which involve much weight-carrying, the deformity is apt to supervene. Thus bakers are particularly apt to become in-kneed. In young children the most common cause is malnutrition; it is especially apt to be found in those who have been brought up by hand, and who have been surrounded generally by a defective hygiene. In the writer's experience, children who have been reared on condensed milk and a farinaceous diet are likely subjects of knock-knee. These rickety children have generally a heavy trunk and a large head, which the ill-developed legs and feet are unable properly to support, and if the ligaments yield rather than the bones, flat feet and knock-knees are the result. When once started, the deformity increases rapidly.

Probably heredity has but little direct influence on the condition, though parents of feeble constitution, themselves valgous, are likely to have weak-kneed offspring. In estimating the amount of the deformity, the leg should be fully extended, so that the lateral ligaments of the joint (which are behind its vertical axis) may be rendered tense, and the tibia rigidly locked upon the femur. If the least amount of flexion be permitted, the valgous condition may be completely effaced. When the patient is lying supine, the patellæ should be made to look directly upwards; these bones are displaced considerably outwards on account of the deflected course which the rectus femoris has been made to take in the valgous knee. At times one limb is found valgous whilst the other is bandy, as is explained under Bow-Leg.

Treatment.—In the early days of genu valgum, the treatment will involve care in the matter of clothing and diet. The child should be taken completely off his feet, and the mother or nurse should rub the legs and feet well, in front of the fire, and should see that the circulation in them is always active. She must be instructed also in trying to straighten the extended limb by judicious, firm, and repeated efforts, five or six times a day. From time to time also the surgeon should manipulate the limb. If only one limb be affected, a well-padded outside splint may be applied to the limb, firmly strapped or bandaged to it. If both knees be valgous, a firm, flat pillow may be fixed between the knees and the ankles tied together. On no account should the child be allowed to stand or walk. If the treatment prove slow or unpromising, the surgeon may attempt the straightening of the limb, under chloroform, by forcible manipulation.

In many cases this treatment answers well. After the straightening, the limb may be fixed in lateral splints of plaster of Paris, or the straightening may be effected more gradually by a hinged splint, working with a rack and pinion. But in those cases in which, from one cause or another, this treatment cannot be employed, or in which, being tried, it proves ineffectual, osteotomy may be resorted to with advantage. *See* OSTEOTOMY. EDMUND OWEN.

GIBSON'S SPLINT FOR FRACTURED THIGH consists of two long splints, with a crutch for the axilla at the upper end of each; the lower end of each splint is perforated by a series of holes for pegs, and fits into a slot in a footboard. Counter-extension is maintained by the pressure of the crutches against the axillæ, and extension is made by pulling on the footboard, to which the feet have been fixed; when sufficient extension has been made, the footboard is prevented from slipping back by pegs placed in the proper holes in the splint. BILTON POLLARD.

GINGIVITIS. *See* GUMS, Affections of.

GLANDERS (*Synon.* Equinia; Farcy) is an inflammatory affection of the nasal mucous membrane, to which horses, mules, and asses are liable; and it is occasionally communicated to those who tend them by accidental inoculation, or by absorption of the specific contagion through the unbroken skin or mucous membrane. Farcy is the name given to a peculiar inflammation of the subcutaneous lymphatic vessels and glands, accompanied by the formation of hard swellings which break down into foul ulcers. Both these affections are manifestations of the same specific disease, and it is probable that their differences are determined by the mode in which the contagion is received. In man, as in animals, the disease may run an acute or chronic course.

Course and Symptoms.—After an incubation of three to eight days in the more acute forms, but extending to several weeks in more chronic cases, the onset of the disease is marked by languor and feverishness, pains in the joints and muscles, and chilliness or even rigors. The wound by which the virus has entered, although it may have healed, becomes inflamed, and a chancroid ulcer forms, with red, swollen, and very tender margins. In other cases, however, there is no such evidence of the seat of inoculation. The characteristic features of the disease soon appear in the form of (1) hard swellings under the skin and in the muscles; (2) a cutaneous eruption; and (3) an ulcerative inflammation of the mucous membrane of the nose.

1. To the pains in various parts of the body succeed diffused or circumscribed elevations in the subcutaneous or muscular tissues. They are hard, tender, and very painful, and they soon break down into foul, deeply excavated ulcers. Some, however, after a time, undergo resolution and disappear. At the same time a corded state of the lymphatics may be observed, not only near the seat of inoculation but in other regions, and this is accompanied by glandular swellings similar to the 'farcy-buds' which occur in the horse.

2. A peculiar skin-eruption appears somewhat later. At first papular or even tubercular, it soon develops into pustules or blebs containing sero-purulent material. These are scattered in irregular groups over the surface, and especially over the face, chest, and abdomen. Sometimes they are very hard, and slowly soften, resembling small boils; at other times they form flattened, irregularly-shaped vesicles or bullæ of various sizes, surrounded by a livid erythematous swelling of the integuments, and they are succeeded by foul, superficial ulcers.

3. Usually the latest, but occasionally the first, symptom is an inflammation of the nasal mucous membrane. A thin, clear discharge like that from an ordinary coryza is noticed. Soon this becomes viscid, sanious, and offensive. The mucous membrane swells, and patches of ulceration form, with foul crusts upon them. The skin of the nose and of the adjacent parts of the cheeks and forehead becomes red, tense, and swollen, and glandular enlargements appear in the parotid and submaxillary regions. The inflammation may also extend to the frontal sinuses, the tonsils, and the air-passages, and the eyelids may be glued together by a similar discharge from the inflamed conjunctivæ.

The constitutional symptoms, meanwhile, tend to assume a typhoid character. Muscular tremors, muttering delirium, sour sweats, and diarrhœa supervene. In the most acute forms the patient may die exhausted in three or four days, even before the third stage has been reached. Few survive for more than three or four weeks, and in the more chronic cases it is usually many months before the abscesses heal and the patient recovers.

Pathology.—According to Virchow, the nasal affection and the cutaneous eruption are both due to the formation, in the substance of the corium, of tubercular masses, which caseate and then soften down into suppurating foci. The larger nodules in the subcutaneous and deeper tissues are due to similar deposits of caseous material which degenerate into hæmorrhagic abscesses. After death the blood is usually found to be fluid, the muscles soft and rotten, and there are changes in the viscera which bear a close resemblance to those found in pyæmia.

The *diagnosis* is at first obscure. The fever and vague pains may be confounded with rheumatism, and when the swellings have appeared it may be difficult to distinguish the acute form from pyæmia, and the more chronic form from tertiary syphilis or scrofula. The patient's antecedents will probably give some clue, and the diagnosis will soon be confirmed by the appearance of the eruption. This has been mistaken for varicella and smallpox, and, later on, for ecthyma and pemphigus; but the fact that it is associated with hard or suppurating subcutaneous swellings ought to suffice for its recognition. The acute character of the nasal affection, together with its concomitants, will distinguish it from the various forms of ozæna.

Treatment.—It will be necessary to support the patient by a liberal diet with alcoholic stimulants. Quinine in five to ten-grain doses should be given three times a day. Other aseptic remedies, such as sulphite of sodium, deserve a trial. Mineral acids, perchloride of iron, and other tonics, will be useful in the more chronic cases, and opium will be required to alleviate the severe muscular pains, as well as to induce a more healthy action in the local inflammations.

The original seat of inoculation, as soon as there is reason to suspect its dangerous character, should be cauterised with nitric acid or potassa fusa. The abscesses should be freely incised, and their cavities well washed out with carbolic acid, and dusted over with iodoform powder. Similar applications must be used for dressing the superficial ulcers. The nose must be repeatedly syringed with antiseptic solutions, and the patient should be directed to inhale frequently vapour charged with iodine, creasote, or carbolic acid.

Equinia Mitis is a milder disease, consisting of an eruption of pustules and bullæ, which sometimes attacks the hands of those who have to dress the heels of horses affected with 'the grease.' It appears to have no relation to glanders, and its treatment will be cleanliness, with the application of liquor plumbi subacetatis dilutus, or a weak solution of carbolic acid.

N. Davies-Colley.

GLANDS, LYMPHATIC, Affections of. *See* Lymphadenoma, &c.

GLAUCOMA, in its most general acceptance, signifies all those conditions in which the eyeball is unduly hard. But it is necessary, for the proper study of its pathology and treatment, to separate the cases of primary glaucoma from those in which the hardness is merely secondary to some other recent morbid condition—e.g. iritis, intra-ocular tumour, &c. The subject of secondary glaucoma will be separately discussed later.

The hardness of primary glaucoma may be permanent or but temporary, recurring from time to time. Such temporary cases pass ultimately, if unchecked, into the permanent condition. They are known by the name of intermittent glaucoma.

Though numerous and most ingenious instruments called 'tonometers' have been constructed, yet the tension of the globe is now universally estimated by the finger of the surgeon. The eye, while open, and directed gently downward, is felt through the upper lid by the two index fingers. The estimation is made by the amount of dimpling effected by slight alternate pressure of the fingers, or by the feeling of resistance imparted to the touch. In any case the standard is a purely arbitrary one, and consequently varies with different observers, and even with the same observer at different periods. The other eye of the patient, if sound, will afford some guide. Three degrees of increased or diminished tension are usually recognised, the first being represented by T_1, T_2, and T_3, and the last by $-T_1$, $-T_2$, and $-T_3$. Between the two series stands normal tension, T_n. T ? expresses a doubt whether there is any deviation from the normal; but T_1 ? or $-T_1$? accepts the increased or diminished tension, but is uncertain as to its degree.

Glaucoma is comparatively a rare disease, being met with in one out of about two hundred and fifty cases of eye-disease. Four-fifths of the sufferers are over forty years of age. It affects the sexes in not very unequal proportion, though the statistics of various authors make it a little more common among males.

Briefly speaking, the diagnostic symptoms of a primary glaucoma are, *in the premonitory stage*, unduly failing accommoda tion, frequently repeated attacks of foggy vision, and halos; *later*, hardness of the eye, with, in all probability, cupping of the optic papilla or disc and contraction of the field of vision. *See* PERIMETRY.

Primary glaucoma is usually divided, for clinical purposes, into two groups—the non-inflammatory and the inflammatory.

The *non-inflammatory* is the one more commonly encountered, especially among men, where, according to Nettleship, it constitutes 75 per cent. of all the cases; whereas in women it forms but 52 per cent.

A typical case of non-inflammatory glaucoma would be as follows:—The patient, who may well be a man of from fifty to sixty years of age, makes complaint of long-standing occasional aching in the eyes and difficulty in reading. He has changed his reading spectacles several times recently without much benefit. It is found that he is more presbyopic than usual at his time of life, even when allowance is made for the hypermetropia which he usually exhibits. For some time he has had occasional attacks of foggy vision, with coloured rings or halos round an artificial light. The pupil is sluggish; the anterior chamber rather inclined to be shallow, but the cornea fairly bright. Light thrown into the eye by the mirror alone shows the lens and other media to be perfectly transparent. While there is some general impairment of sight, the defect is far greater at the peripheral portions of the field of vision, especially at the inner or nasal part, so that fingers, or, better, a white spot, cannot be perceived till nearer the point of central vision than normal. The ophthalmoscope shows the optic disc to be excavated so as to form a cup narrowed at its mouth. Its base—white, with a bluish tinge—shows greyish mottlings corresponding to the pores of the lamina cribrosa. Its vessels, only slightly diminished in size, are visible where they emerge at the bottom of the cup and as they wind round its overhanging edge; but between these two points they lie along its hollowed-out sides, and so are hid from view. The disc may be fringed by a pale ring of atrophied choroid. Closer examination by the erect image shows a pulsation not only of the veins, but also of the arteries; or this latter sign, if wanting, may be produced by slight pressure of the finger on the globe. The eye is distinctly harder than normal, though not excessively so. No outward signs of inflammation or vascular congestion are present.

An *inflammatory* glaucoma in its more acute form (glaucoma acutum) presents changes for the most part similar. But its onset has been more sudden, unless, indeed, it has supervened upon a glaucoma simplex, and is frequently marked by neuralgic pain in the eye or round the orbit, or possibly by vomiting. There is lacrymation, with great vascular congestion, both ciliary and conjunctival, and possibly even swelling of the upper lid. The anterior ciliary arteries are decidedly larger and more tortuous than normal, and their very superficially placed communicating vessels are also large. The iris is dull and discoloured, and the dilated inactive pupil not infrequently oval in a vertical direction. The anterior chamber is markedly shallow, and the cornea steamy. The lens, though transparent, has a smoky appearance. Ophthalmoscopic examination is difficult, and sometimes impracticable, from corneal and vitreous haze. Cupping of the disc is not so constant or so well-developed as in glaucoma simplex on account of the less average duration of the disease; indeed, it may be entirely wanting, and the disc be simply red, with large and apparently numerous pulsating vessels; or it may be indistinguishable on account of opacities in the media, as above mentioned. Limitations of the visual field are not so striking or so easily detected as in glaucoma simplex, a condition dependent to some extent on the more marked general impairment of sight. The eye is decidedly hard (T_2 or T_3).

Inflammatory glaucoma is usually subdivided, for clinical purposes, into two forms —glaucoma acutum and glaucoma chronicum.

Very rarely it happens that an inflammatory glaucoma is so rapid and severe as to reduce the vision to perception of light, or even destroy it altogether within a very short time—perhaps only twenty-four hours. To this variety of acute inflammatory glaucoma the name of *glaucoma fulminans* is applied.

Sometimes the glaucomatous outbreak is preceded by the appearance of numerous small retinal hæmorrhages. To such cases the name of *glaucoma hæmorrhagicum* is given. This group is important in a clinical sense, as this form of the disease is little amenable to ordinary operative treatment. Still more rarely glaucoma is preceded by swelling of the optic disc. It is questionable, however, whether the disease can then be ranked as a primary glaucoma at all. The same remark applies to hæmorrhagic glaucoma. Glaucoma, in whatever form, has its later stages characterised by still diminishing sight, both central and peripheral, by increasing whiteness of the floor of the cup.

and by diminishing size of the retinal vessels. The widely dilated pupil may be reduced to a mere rim. The cornea becomes quite anæsthesic, but there may be occasional attacks of severe neuralgic pain both in and around the orbit. Minute retinal hæmorrhages are not uncommon, but they may be obscured by the development of the cataractous condition. In cases of long standing there may be corneal opacities of inflammatory origin, which are apt to take the form of a superficial, horizontally-running, transverse band.

Any case of primary glaucoma which has so far progressed as to be hopeless, passes by the name of *glaucoma absolutum.*

Cases are also not infrequently observed where, though all the other usual symptoms of glaucoma simplex are present, inclusive of the cupped disc, no increase of tension is perceptible to the finger. In such we may accept the arterial pulsation and the usually well-marked cup as indicative of some long-continued increase of pressure, too slight for appreciation by our ordinary methods, or we may find a definite history of occasional outbursts of tension (glaucoma intermittens).

Glaucoma, though rare, is not wanting in children and young adults. In such cases the sclerotic yields gradually to the pressure, the change being more noticeable in the anterior half of the eye, especially in the cornea. The disease has consequently passed under the name of ‘buphthalmos’ or ‘hydrophthalmos.’ But the more numerous cases where this condition is secondary to iritis in infancy, or, more commonly, in intra-uterine life, should be carefully distinguished from those in which the buphthalmos indicates primary glaucoma occurring in young subjects.

It is clear that opportunities of examining early and slight cases of glaucoma must be, of necessity, rare in the extreme. But the pathological changes of advanced glaucoma are well-determined, though authorities are by no means agreed as to the precise significance of each and their relative order. Taking, therefore, a chronic inflammatory glaucoma which has attained the absolute stage, the globe is of about normal size and the conjunctiva extremely thin. Small bluish-black areas often mark the existence of local thinnings of the sclerotic. Two such—at the outer and inner equators respectively—are of common occurrence. They correspond to the terminal part of the course of the long ciliary arteries and nerves within the substance of the sclerotic, and are correspondingly elongated in form from before backwards. The nerves themselves are usually of large size, as are also the accompanying arteries. The optic nerve is smaller in section as well as more firm and unyielding than normal, though its mouth is somewhat widened from a yielding of the fibres of the lamina cribrosa. The globe, when divided across its equator, stands up well against the knife, on account of the firmness and full size which the vitreous body usually presents. The iris is advanced, so that its widely-dilated pupillary margin no longer rests upon the lens, and its excessively atrophied peripheral part firmly adheres to the corresponding anterior, or rather outer wall, of the anterior aqueous chamber. The rest of it is also much atrophied, apparently from long-standing inflammation, of moderate severity though of low type. Its anterior surface is shortened, so that the uveal pigment, rolled forward into view, lines the pupillary margin with black. The ciliary body and the iris have their afferent arteries enlarged and patent. The shrinking of the ciliary body may be such as ultimately to reduce it to half its original thickness. This change is associated with the formation of more or less connective tissue between its much-atrophied muscular fibres, the product of a low form of inflammation, as in the iris. The pigment epithelium of both iris and ciliary body remains unaltered. The ciliary folds are commonly much shrunken. The optic disc may be encircled by a narrow zone of atrophy, but otherwise the choroid is normal. The retina is also normal in structure, except for some atrophy of its nerve-cell and nerve-fibre layers, and a diminution in the size of its arteries and veins. The walls of both arteries and capillaries are hyaline and rigid, and aneurismal dilatations of the latter are not uncommon. The retina is commonly cystic where it borders upon the ora serrata.

The connective-tissue framework of the optic nerve is much thickened and very irregular. It supports many large blood-vessels, and encroaches very much upon the nerve-bundles, which, like the trabeculæ, show a very marked hypernucleation. The cupped and atrophied disc may be lined by imperfectly formed non-vascular fibrous tissue. The vitreous is usually slightly yellowish in tinge; it is comparatively easy to find cell-elements in it. The canal which traverses it—the canal of Cloquet—may be found enlarged, especially at its posterior part. The lens is usually of average size, except when it is cataractous, in which case it is for the most part somewhat diminished.

Some few cases, however, occur where it is large, soft, and globular—the result, in all probability, of an early stage in the formation of cataract, similar to that sometimes also encountered in eyes with normal tension.

The exact condition of things in the earlier stage of glaucoma may be inferred from the comparatively few examinations that have been made, and from the ophthalmoscopical and clinical appearances. It is certain that the lens and iris-base are at first free from the cornea, but that they afterwards become advanced by pressure from behind in the course of development of the disease. The writer is also satisfied that the inflammation and atrophy of both iris and ciliary body are also consequences of the increased pressure. Both are, in all probability, the direct result of the application and resulting inflammatory adhesion of the iris-periphery to the cornea. The changes affecting the optic disc, as well as those within the optic nerve itself, are also secondary to the increased pressure within the vitreous chamber. Some uncertainty exists as to the state of the ciliary folds. It is maintained by some that they are congested and consequently enlarged in the earlier stages of glaucoma. Such a condition is not improbable in view of the supposition of an increased flow of fluid into the eye, though the evidence at present before us is not sufficient to establish it.

The pathological differences in the various forms of glaucoma relate to the period and degree of development of inflammatory symptoms, these being entirely wanting, so far as external appearances are concerned, in glaucoma simplex (at all events, in all but its later stages), whereas they are observable in inflammatory glaucoma from its very outbreak.

The original development of a primary glaucoma is due to a disturbance in the balance of the intra-ocular fluid, to the origin and course of which it is consequently necessary to devote a short space. According to common acceptance it is secreted mainly by the pigment-epithelium of the ciliary folds, and to a less degree by that of the ciliary body generally and posterior iris-surface. From the ciliary body it passes centripetally—some into the posterior aqueous chamber, some into the adjacent lens-margin, but most into the vitreous chamber, where it tends to accumulate in the canal of Cloquet. From these various parts it passes forwards by way of the pupil to the extreme peripheral part of the anterior aqueous chamber, where it filters through the epithelioid cells of the meshwork of the ligamentum pectinatum into the canal of Schlemm, whence it gains the episcleral veins. That portion coming from the vitreous chamber has passed round the lens margin, either between it and the ciliary folds, or along the grooves between the latter, into the posterior aqueous chamber, and so on through the pupil as above described. An obstruction to this flow at any point of its forward course, or a secretion of the fluid in larger quantity than can traverse the normal outlets, will constitute a glaucoma.

There is strong evidence that the fifth nerve determines the amount of secretion into the eyeball. Experimental irritation of this nerve has caused the tension to rise, and glaucomatous attacks are often ushered in by neuralgia of one or more of its branches, though we must not forget, on the other hand, that trigeminal neuralgia is far more commonly unaccompanied by any change in the tension. Paralysis of the fifth is sometimes associated with distinct slackness of the eyeball, and the same result is favoured by stretching the supra-trochlear branch of this nerve. It is likely that, as the tension of the eyeball has been found to bear a distinct relation to the blood-pressure, the influence of the fifth may be exerted through its connection with the sympathetic.

The phenomena of intermittent glaucoma, of sudden outbreaks of tension, especially when preceded or accompanied by neuralgia of the fifth nerve or much lacrymation, of increased or diminished tension following a blow without apparent structural change, are all totally irreconcilable with the production of glaucoma by obstruction. Moreover the action of eserine, which by contracting the sphincter muscle of the iris and thereby opening more widely the meshwork of the ligamentum pectinatum, does in certain cases reduce the tension to normal, shows that the fault lies neither in closure of the outlets, which are really capable under the influence of this drug of transmitting a far larger quantity of fluid than normal, nor in the nature of the fluid itself.

Therefore the writer adheres most unreservedly to the view first enunciated by Donders, that the original cause of a primary glaucoma is an undue secretion into the eyeball. But, at a more advanced stage of the disease, obstruction to the normal outflow at the ligamentum pectinatum is superadded, this being a direct mechanical result of the previously existing hypersecretion.

The various pathological changes of glaucoma are perfectly explicable on the hypothesis of an increased secretion followed by a secondarily produced obstruction. The accumulation of fluid within the substance of the vitreous itself and in its central canal thrusts forwards the lens and ciliary folds, and with them the adjacent iris-base. If the quantity be large, as in the inflammatory forms of glaucoma, the iris-base becomes actually applied to the meshwork of the ligamentum pectinatum, thereby effectually blocking it. The same result is favoured, both here and in the later stages of glaucoma simplex, by paralysis of the muscular fibres of the iris from pressure in the course of their afferent nerves. The iris-base becomes inflamed, and subsequently atrophied, in consequence of its compression. The same changes extend to the rest of the iris and to the adjacent muscular fibres of the ciliary body.

There has been much discussion as to the exact means by which the iris-base is advanced. Though it is now certain that the anterior extremities of the ciliary folds are the immediate propelling agents, yet the difficulty is thus merely removed one stage backwards. Some have said that the folds are so much swollen in glaucoma as to press upon the iris. But swelling of the ciliary folds is at least as well established in many diseases, with normal tension and no advance of the iris, as in the early stage of glaucoma. Nor would this supposition account for the advance of the lens, unless indeed it were maintained (as has been done) that the swollen folds and the lens together form a diaphragm impermeable to the proper passage of fluid from the vitreous chamber. But the iris-periphery is as readily advanced after the extraction or dislocation of the lens as when this body is intact. Consequently we are driven to the conclusion that it is the vitreous body itself which presses upon the ciliary folds, and through them upon the iris-base. In the rare cases where the vitreous does not occupy its entire chamber, the pressure must come from the fluid accumulated behind it.

The inflammation of the trunk of the optic nerve has attracted less attention. It is developed just as strikingly in glaucoma distinctly due to blockage of the ligamentum pectinatum—for example, in cases of perforated corneal ulcer with prolapse of iris—as in primary glaucoma. The writer attributes it to infiltration of the ocular end of the optic nerve by fluid from the vitreous cavity. It is a question whether this infiltration, its existence being granted, is an entirely new development under the influence of the increased intra-ocular pressure, or whether it is simply an exaggeration of a normally existing flow. In favour of the latter view is the fact that the lymph-spaces of the optic nerve communicate with the canal of Cloquet, as well as with the sub-hyaloid space; and, more decidedly still, that swelling of the disc, narrowing of the peripheral part of the anterior aqueous chamber, and even, in rare cases, glaucoma itself, can be produced by compression of the optic nerve. Mooren states that the intra-ocular fluid of glaucoma is less albuminous, and consequently less coagulable, than normal. If so, the change in quality may have some deleterious influence on the tissues of the optic nerve. If we accept a normally existing outflow along the nerve, we must suppose this to be extremely slight compared with that by way of the ligamentum pectinatum; since experimental injections into the vitreous chamber have given no indication of their penetration in the nerve, and since all sorts of affections of the optic nerve may exist without a change in the tension of the eye. The widening of the nerve-entrance from stretching of the fibres of the lamina cribrosa would favour a flow of fluid into the nerve. We must, however, remember that to the ophthalmoscope the optic disc usually appears altered, prior to the establishment of any tension appreciable by the touch. But, on the other hand, we must bear in mind that even then pulsation of the retinal arteries is either present or very easily producible. Probably a long-continued slight hypersecretion may be got rid of through the normal outlets without producing any obvious rise of tension, and nevertheless may excite slow inflammatory changes within the ocular end of the optic nerve.

The advanced lens will naturally recede to its former position so soon as the pressure in front and behind it becomes equalised. This will be the case so soon as the ligamentum pectinatum becomes completely obstructed, and the secretion of the ciliary folds diminishes as the result of their shrinking. But the adherent iris must necessarily maintain its advanced position.

The various symptoms of glaucoma can also be explained by its pathology.

The dull and steamy appearance of the cornea, in inflammatory glaucoma, is due to distension of its lymph-spaces and an alteration in its anterior epithelial layer. The dull fundus reflex is due partly to this and partly to haze of vitreous, a result of its increased fluid and cell contents, which will also account for the halos and attacks of foggy vision. The failing accommodation is attributable to tension of the suspensory ligament of the lens and inelasticity of the sclerotic, both direct results of the distension of the eyeball and its approach to a spherical shape. The redness and subsequent atrophy of the disc are accounted for by the changes within the nerve. The limitation of the visual field, when temporary, is due to ischæmia of the retina. When permanent—i.e. when not remediable by the re-establishment of normal tension—it is due to the destruction of the nerve-fibres at the place where they are compressed along the sides and round the edge of the excavation. The inner part of the field is the first to go, since the arteries supplying the corresponding outer part of the retina have the longest course. The field for colour shrinks *pari passu* with that for form. But we must remember that the condition of the optic nerve itself must soon be sufficient to damage, and ultimately to destroy, both peripheral and central vision.

The pulsation of the vessels is a direct result of the diminished elasticity of the tunics of the globe from the pressure. The entry of the blood at each beat of the artery is no longer provided for by the slight dilatation of the globe which should normally occur. Consequently it is compensated by an immediate collapse of the vein to the same extent, and we have venous pulsation. Later, the increasing hardness of the globe allows an admittance of blood to the arteries at the moment of the systole only, and we have a visible arterial pulsation also. The pressure of the finger on the globe will diminish the elasticity of its coats, and thus give rise to pulsation of the arteries, the ease with which this is produced being a measure of the tendency to glaucoma. The paralysis of the iris and anæsthesia of the cornea are probably direct results of the pressure on the ciliary nerves, where they course between choroid and sclerotic. The dilatation of the pupil to a mere rim, as so commonly occurs in glaucoma absolutum, is due both to paralysis of the iris in association with the rolling forwards of its pupillary edge, and to the adhesion of its base to the peripheral part of the front wall of the anterior aqueous chamber. The cupping of the optic disc is in the main a direct result of the pressure. It is due to the atrophy of the nerve-fibres, both directly from the pressure and from the changes within the nerve. It takes time—probably at least a month in inflammatory glaucoma—for its complete development. It commences as a funnel-shaped central pit, which gradually extends till it reaches nearly or quite up to the margin of the disc, where a narrow, well-defined, white ring—the scleral ring—is often conspicuous. Gradually the nerve-fibres are pressed against its sides and atrophied here, as well as at its overhanging edge, so that the cup becomes flask-shaped in antero-posterior section—that is to say, its mouth is narrower than its cavity.

This overhanging, which need not involve its entire circuit, is due to the tapering of the normal optic nerve just before and at its entrance to the eye. This is a result of an anatomical change in the nerve-fibres, which normally lose their white matter of Schwann about the level of the lamina cribrosa, and are, consequently, for the rest of their forward course, represented by the axis-cylinders alone. The peculiar shape of the cup explains the apparent interruption of the vessels, as previously described. The most typical cupping is seen in glaucoma simplex. It is not well exhibited in the glaucoma of myopic eyes, probably from the distensibility of the thinned tunics of the globe. It used to be taught that a cup must occupy the whole of the disc, and, moreover, have an overhanging mouth in order to indicate a glaucoma. The idea is certainly incorrect as regards the first-mentioned condition, and apparently also as regards the last, since such a cup is not infrequently seen without any appreciable increase of tension. But it is certain that an extensive cup with undermined edges is typical of glaucoma, as compared with certain other conditions. For an atrophic cup, though extensive, is saucer-like, and a physiological cup, though its edge may be undermined, does not involve the whole of the disc.

Glaucoma probably depends upon some constitutional tendency or disturbance. It has been attributed to gout, but, though many patients with glaucoma undoubtedly have a gouty history, no such evidence has been hitherto collected as would warrant an absolute statement. The tendency to the disease is distinctly hereditary. Hypermetropia, excessive use of the eyes in near vision, uncorrected presbyopia, great anxiety, mental emotion or exhaustion, doubtless predispose to an attack.

Glaucoma is far more common as a disease secondary to other affections than in its primary form. Secondary glaucoma is encountered in the progress of most intraocular tumours, whether such be sarcomata of the uveal tract, retinal gliomata, or tuberculous. The effect of an intra-ocular growth upon the tension appears to be twofold. Its first and direct effect is to render the eye very slightly slack, possibly by the absorption of vitreous which it induces; an absorption which proceeds even more rapidly than the tumour grows. But the later outbreak of an inflammatory glaucoma is due to some cause not yet determined with precision. It probably varies in each case, being sometimes due to the blockage of the anterior outlets by the iris-periphery under the direct pressure of the now rapidly increasing tumour mass in the vitreous chamber. But more often the growth seems to prevent the flow from the vitreous chamber itself round the lens-margin. It is also a clinical fact that some tumours lead to shrinking of the eye without any manifestation of tension at any time, while others, large enough to reach nearly or quite up to the posterior lens-capsule, may exist for long with slightly diminished or normal tension.

Secondary glaucoma also occurs very commonly after perforated corneal ulcers. If the destruction affect a considerable area of cornea, the whole pupillary part of the iris prolapses into the gap thus made, and the pressure from behind applies the remaining part to the undestroyed cornea, thereby excluding most effectually all drainage by the canal of Schlemm. Similarly, after more extensive slough of the cornea, the exposed iris unites together, so that the pupil no longer exists. Thus a diaphragm is formed which becomes rapidly covered by a layer of lymph. Till this is slowly organised into dense fibrous tissue, it is incapable of resisting the intra-ocular pressure, and we have a prominent corneal staphyloma gradually formed. So soon, however, as a certain amount of firmness is gained, a secondary glaucoma is established. Prevention, by freeing the iris, is difficult, and relief of the glaucomatous condition, when once established, either by iridectomy or by any other procedure, still more difficult and uncertain. Indeed, little remains to us in the later stages but to mitigate the deformity, as far as possible, by tattooing the cornea, by abscission of the globe posterior to the ciliary body, or by enucleation.

Secondary glaucoma may also be produced in the course of iritis by adhesion of the iris to the anterior lens-capsule. In such cases the pupillary margin alone may be adherent (exclusion of the pupil), or the adhesion may involve a great part, or even the whole, of the posterior iris surface (universal posterior synechia). Thus, fluid is prevented from escaping by the anterior outlets of the eye, and we have a rise of tension with a diminution in the size of the anterior chamber.

It is remarkable that the pupil may be excluded and still the tension may remain perfectly normal, or even may be diminished, whether the iris be bulged or remain flat. Under the same circumstances increased tension may suddenly arise, or a hard eye become normal. The explanation resides in a varying amount of secretion of the ciliary body, according to its condition, whether normal, or inflamed, or inclined to atrophy after inflammation. The appearances in glaucoma from excluded pupil are characteristic, and the remedy simple. The central part of the anterior chamber is funnel-shaped, the apex of the funnel being formed by the pupillary area of the lens, and its base by the cornea. All the rest of the anterior chamber is extremely shallow, being encroached upon from behind by the bulged iris. An iridectomy will re-establish communication between the chambers, and effect very commonly the cure of the glaucoma. More extensive or universal posterior synechiæ are naturally less remediable by iridectomy. Indeed the indication for it is not so certain, since so extensive an iritis usually brings with it cyclitis and a subsequent softening of the eye.

Glaucoma also occurs commonly in the course of an iritis serosa. Since the secretion of the iris itself, especially its anterior surface, is here augmented, being, indeed, the cause of the increased tension, we have the anterior chamber markedly deep, and the iris-periphery pushed far back from the cornea. Numerous loosely arranged cells are found in the meshwork of the ligamentum pectinatum, and it has consequently been maintained that these produce the tension, by causing a direct obstruction at this, the point of outflow. This is probably not the case, since a similar accumulation of cells occurs commonly in suppurative iritis in association with normal tension. The most advantageous treatment of the tension of iritis serosa is not determined with certainty. If the disease has persisted for very long, the iris-periphery will usually be found applied, and the iris atrophied, as in an ordinary glaucoma absolutum.

Dislocation of the lens, whether into the vitreous or aqueous chamber, is very commonly followed by rise of tension. Indeed, slight lateral displacements appear just as liable to produce a glaucoma as the most extensive and violent changes of place. A displaced lens may block the meshwork of the ligamentum pectinatum by its presence in the anterior chamber, or by its direct pressure from behind upon a portion of the iris-periphery. Where such pressure cannot be proved to exist, it has been supposed that the displaced lens produces an irritative hypersecretion from the ciliary body by traction on the zonula. The question is not yet cleared up satisfactorily; but it is certain that the vitreous, after removal of the lens, or after its displacement with rupture of the hyaloid, is just as competent to thrust forward the ciliary folds and iris-periphery, as the lens would be with its normal attachments still unbroken. This result can scarcely be due to any other cause than swelling of the vitreous or an alteration in its shape. It is also to be noted that the tension due to lenticular dislocations may vary very much, a sudden outbreak of glaucoma being perhaps followed by a temporary period of diminished pressure. Secondary glaucoma, immediate or after the lapse of some months, was a common cause of entire loss of sight after the old cataract operation of couching or depression. Extraction of the displaced lens is the clearly indicated remedy, but it is not done without considerable difficulty, and there will almost certainly be loss of vitreous.

Wounds of the lens, accidental or operative, may be followed by glaucoma. In many such cases the lens is demonstrably swollen, and must encroach directly upon the cavity of the globe. To what extent it may have an indirect effect in closing the periphery of the anterior chamber or exciting an irritative hypersecretion from the ciliary folds, is less certain. The tension may be relieved by a speedy evacuation of the soft lens-matter by a curette through a small corneal incision, or by extraction of the lens *en masse* by the ordinary methods.

Glaucoma may supervene after a blow, without obvious structural change, or after a small perforating corneal wound with prolapse of iris.

Increased tension is also common in the course of suppurative panophthalmitis, and is doubtless directly due to swelling of the vitreous from abundant infiltration with cell-elements. It is not uncommon in uveitis of sympathetic origin. In both these cases the eye manifests a subsequent tendency to shrink; in the first, certainly, and in the last, probably. Scleral puncture or enucleation may be resorted to in suppurative panophthalmitis. In sympathetic disease we must be cautious about undertaking any operation, but, if the tension absolutely necessitates some interference, it will probably be found best to do sclerotomy.

High tension may also occur in the course of inherited syphilitic kerato-iritis, or indeed in the course of any serious affection of the uveal tract. In the former case it will often fall spontaneously to normal or even be followed by an abnormal softness of the globe. The need of an operation—best, probably, an iridectomy—will be determined by the probable effect of the tension on the nervous tissues of the eye.

Hæmorrhages between the choroid and retina are not infrequently the cause of a secondary glaucoma, especially in defective eyes. They are not uncommon in children, where they constitute one form of what has been described as pseudo-glioma.

It has already been stated that glaucoma may occur second in point of time to retinal hæmorrhage, in which case it is called hæmorrhagic glaucoma. This and the glaucoma which not infrequently follows plugging of the central vessels of the optic nerve may be, in reality, forms of secondary glaucoma; being perhaps related to an interference with the flow of lymph from the retina itself and vitreous cavity into the lymph-spaces of the nerve, either alone or, more probably, in association with some extensive vascular disease leading to an increased secretion from the ciliary body.

W. A. Brailey.

GLAUCOMA, Treatment of.—All authorities have agreed to make tension the diagnostic symptom of glaucoma, and with some practical reason, since it is the cause of a far more rapid deterioration of vision than would otherwise occur, and since it is the one condition we have some power of remedying. The effects of tension may be experienced by anyone making pressure with the finger on his own eye. The sight fails progressively from the circumference to the centre of the field of vision, and is re-established progressively on removing the pressure. The effects of removing morbid pressure are occasionally brilliantly demonstrable after operations for the acute inflammatory, and especially the fulminating variety of glaucoma. But, on the whole, the treatment of glaucoma can hardly be pronounced satisfactory. Except for combating any gouty, or possibly any general rheumatic, symptoms, and giving suitable glasses and instructions for the use of the eyes, we can do nothing in the premonitory stage. The question of proper spectacles, especially for near work, is, however, far more important than is often supposed. It is very probable that an iridectomy or, better, a sclerotomy, might check the further development of the pressure, but few surgeons would propose, or few patients would risk, an operation while still vision was good and an increase of tension but doubtful.

With regard to drugs, the subcutaneous injection of morphia (gr. $\frac{1}{6}$ of the hydrochlorate) under the skin of the temple will relieve the pain and, very occasionally, even reduce the tension to normal. A violent purgative has also a distinct reducing effect on the tension, but we may lay down generally that the known action of all drugs is at present simply temporary. Undoubtedly the most valuable is the Calabar bean, which in the form of a solution of the sulphate of its alkaloid, eserine (gr. ij. ad f℥j.), will sometimes restore normal tension. It is well established by observation that the tension is only reduced when the drug is able to exert to the full its myotic action. Doubtless eserine diminishes tension by gathering the iris more towards the centre of the pupil, so that its peripheral part is thinner and the fibres of the ligamentum pectinatum well stretched apart. Consequently, fluid can transude freely through the periphery of the anterior chamber. On the same principle, atropine, by dilating the pupil, has a tendency to precipitate a threatened glaucoma, the widely dilated iris being much thickened, and the periphery of the anterior chamber, towards which it is gathered, correspondingly narrowed. There has been much misapprehension as to the relative actions of atropine and eserine. For, while the one raises and the other lowers tension by the above-described mechanical action, each drug has an influence of its own on the secretion of the intra-ocular fluids, in an entirely opposite direction. Thus, atropine, by diminishing the secretion according to its well-known action in other regions of the body, tends to lower the tension, and would do so were not this influence more than counterbalanced by the results of its mechanical action on the iris. In the same way, eserine would make the eye harder, were it not that its mechanical action more than counterbalances its influence on the secretion of fluids. It therefore follows that eserine is useful when it contracts the pupil, but that it is actually deleterious in all other cases; also, that atropine may be usefully employed where a rise of tension is associated with a pupil immovable from iritic adhesions, but that it should be sedulously avoided in all cases of threatening glaucoma with unadherent pupil. The weakest solution of eserine that will produce extreme myosis is consequently the best adapted for glaucoma.

Operative treatment is of more avail in glaucoma. Statistics show improvement of sight after operation in about 25 per cent. of the cases of glaucoma simplex, and an actual deterioration of vision in another 20 per cent. The remainder stand in much the same position as regards vision as previous to the operation, though the future course of the disease must be modified beneficially from the reduction of tension which usually occurs. In inflammatory glaucoma, about half the cases are improved in vision, the bulk of the others remaining stationary in this respect. We know, however, that they would all steadily get worse if they remained unoperated upon. The most useful operations are iridectomy and sclerotomy. Others are scleral incision, trephining the sclerotic, hyposcleral cyclotomy, and paracentesis corneæ.

The last has its principal use in reducing tension pending the adoption of some more radical measure. Cases are on record in which such a simple puncture has cured a glaucoma, but anyone expecting to meet with even one such result in his lifetime will probably be doomed to disappointment. It can be performed from below—the best position—with a special broad-pointed stop needle (paracentesis-needle), with the point of a keratome, or with an ordinary broad needle. No anæsthetic is required, provided the operator is moderately skilful. It is surprising how quickly the increased tension and the anterior chamber may become re-established after paracentesis.

Iridectomy was introduced by the genius of Von Graefe in 1856, after a long series of operations, experimentally performed upon animals, had demonstrated to him its utility in reducing the tension of the normal eye.

It still remains the most reliable remedy we possess against inflammatory glaucoma, in both its acute and chronic forms. An anæsthetic should be administered for either iridectomy or sclerotomy. Cocain will, as a rule, not suffice for the perfect quiet which is essential. Chloroform, if not contraindicated by the general condition, is preferable to ether, from the vascular congestion attendant on the latter. The operation is performed with a triangular knife or keratome, whose handle in the immediate neighbourhood of the blade is bent upon the flat, for convenience of operating from above, the usual position. The blade should be of fair size, about 9 mm. in diameter at its widest, and of a length rather greater than this. Some use a smaller size, thereby necessitating a sideways movement in the act of withdrawal, a proceeding not unattended with risk of traumatic cataract. The point of the keratome enters the sclerotic at least 1 mm. behind the apparent corneal margin, care being taken to keep the incision parallel with this. The steady onward movement is facilitated by the use of the fixation-forceps, which take a firm hold of the conjunctiva near the lower corneal margin. So soon as the point of the keratome, which was at first directed towards the centre of the lens, is visible in the anterior chamber, it is turned more forwards, so that the instrument lies, in the rest of its course, perfectly parallel with the plane of the iris. It is quickly and steadily withdrawn so soon as it has traversed about three-fourths of the anterior chamber. During its introduction it should fit the wound so accurately that none of the aqueous fluid escapes by its side; otherwise the lens may be thrust forward on its point.

The keratome is now laid aside and the scissors taken in the right hand, and the iris-forceps in the left. Fixation of the globe by an assistant will probably be necessary. Should the iris not facilitate matters by prolapsing, the closed forceps are cautiously introduced into the anterior chamber, not quite so far as the pupillary margin of the iris, and then opened. The piece of iris grasped by them should be as large as can be safely managed. After being carefully withdrawn it is first cut with the scissors at the extreme right-hand angle of the wound by an incision extending radially to the pupil, and then torn cautiously from its peripheral attachments up to the left-hand angle, where a second radial cut frees it altogether. A certain amount of gentle traction during each cut will ensure that the remaining iris retracts sufficiently to prevent the risk of an anterior synechia. Otherwise, it should be pushed from the wound by some flat, blunt, spud-like instrument made of vulcanite or tortoiseshell. The removed iris should amount to at least one-fifth of the whole.

It is most important that the forceps during fixation should exert no downward pressure on the globe. Nor should it tend to lift it up, but rather rotate it very gently, slightly, and steadily towards the keratome. Some incline the point of the keratome sideways just before commencing to withdraw it, so as to make the length of the internal equal to that of the external wound. Both eyes are kept loosely tied up for two days, and the lint is kept wet and is occasionally changed. During this time rest in bed will be advisable. Then the unoperated eye may be opened under a shade, dry lint being henceforward used to the operated eye. At the end of ten days this may be cautiously exposed to the light, provided that the wound is healed and the anterior chamber fully re-established. But the rapidity of re-formation of the anterior chamber varies much, and may be taken as indicative of the future course of the case. In any case it is much slower, on the average, than after iridectomy on non-glaucomatous eyes. In rare cases the lens and iris remain permanently applied to the cornea without any reduction of tension at any time. To such cases the name of malignant glaucoma has been applied.

When the tension, though still exceeding the normal, has fallen somewhat after an iridectomy, it becomes a question whether a further removal of iris in an opposite direction (diametric iridectomy), or even a sclerotomy, may not be practised advantageously. Tension may, however, remain somewhat in excess, and the eye still be materially benefited by the operation. In such a case it would be prudent to go no further. A Graefe knife may be employed in making the first incision, when, from the great shallowness of the anterior chamber, the use of a keratome would appear to endanger the lens. If the condition of the second eye give rise to anxiety, it is advisable to instil eserine into it, both before and for a day or two after the operation, for the sake of guarding against the outbreak of tension to which the operation on the first eye appears to predispose it.

The accidents attending iridectomy are: wounds of the lens, escape of the lens or of the vitreous and even of the retina, entanglements of the iris in the wound, and intra-ocular hæmorrhages. An ill-made keratome, by allowing premature escape of the aqueous, is likely to be the cause of a traumatic cataract. A Graefe knife, though less likely to injure the lens, has the great disadvantage that, making a larger wound, it allows of a very sudden reduction of the intra-ocular pressure. Thus the danger of rupture of the lens-capsule and of escape of lens, and even vitreous, is greatly increased. The same with regard to intra-ocular hæmorrhages, which, if in the anterior chamber only, may be safely disregarded, but, if in the vitreous, are apt to lead to serious loss of sight. If they are posterior to the retina they may cause an immediate exacerbation of tension, with such prolapse of vitreous, and even of the retina, as may render an immediate enucleation necessary.

Sclerotomy is performed by entering the point of a narrow-bladed Graefe knife 2 mm. behind the apparent corneal margin, and then traversing the anterior chamber parallel to and just in front of the anterior surface of the iris, till a corresponding counterpuncture is made. The incision should comprise a third part, usually the upper, of the entire circle in which it lies. The sclerotic is then divided by gentle sawing movements till only a narrow bridge, 2 mm. wide, remains unsevered. The conjunctiva, yielding to the knife, will only be cut at the points of puncture and counter-puncture. The knife is withdrawn with extreme care, so as to prevent prolapse of the iris. Eserine sulphate (gr. j. or ij. ad f℥j.), is instilled as a further precaution, and repeated thrice daily for some days, provided always that it contracts the pupil. Otherwise the after-treatment is as in iridectomy. It is here also a special point that the bandage should not be firmly applied. The special risk attending sclerotomy, in addition to that of wounding the lens, is entanglement of the iris in the wound. Should this happen during the operation, it will be well to complete the incision, with the knife if it be still in the anterior chamber, or with scissors, and make the sclerotomy into an iridectomy. If the incision be too far back, we have all the risks attendant on wounds of the ciliary region, including those of sympathetic ophthalmitis and deep-seated intra-ocular hæmorrhage. The possibility of a glaucomatous outbreak in the second eye should be guarded against with eserine, as prescribed in iridectomy.

Either sclerotomy or iridectomy may be followed by the condition known as cystoid cicatrix, in which the operation scar at one point, usually near or at an extremity, remains thin, bluish, and prominent. The condition is most plausibly explained by entanglement of a point of iris in the scar. It is usually supposed that a cystoid cicatrix, by allowing occasional leakage, relieves exacerbations of tension. If so, this advantage is too often counterbalanced by the irritation to which this condition gives rise. Its treatment should not be lightly undertaken. It may be cut through with a Graefe knife, and afterwards treated with a compressive bandage and perhaps the occasional use of mitigated nitrate of silver stick. Such treatment, will, however, certainly not be ventured upon if the eye continues hard.

A sclerotomy may be repeated one or more times, or may be followed by an iridectomy. Sclerotomy is certainly preferable to the latter operation in glaucoma simplex, especially if attended with great limitation of the field of vision, also in the hæmorrhagic forms of glaucoma, and for increased tension in young subjects. It has the advantage over iridectomy that it does not deteriorate vision by altering the shape and size of the pupil.

Another operation sometimes employed in glaucoma has been called 'scleral puncture.' An incision, some quarter of an inch long (6 mm.), is made through the sclerotic into the vitreous chamber in an antero-posterior direction. It should lie entirely posterior to the ora serrata, that is to say, it should be at least 6·5 mm. from the apparent corneal margin. The knife, which may be an ordinary keratome, should pass some distance into the vitreous chamber, perhaps as far as the canal of Cloquet. The incision should be between two of the recti tendons, perhaps preferably between the superior and external. After the escape of some of the contents of the globe, such being lymph or thin vitreous, the eye is bandaged carefully, as after iridectomy. For the most part the more thoroughly tried procedures of iridectomy and sclerotomy will be preferred to scleral puncture. But the latter has this advantage, that little reaction follows it, and, being done without an anæsthetic, it can be readily repeated. Its results, provided that repetition be not feared, are spoken of not unfavourably. It is certainly the best operation in cases where the anterior chamber is entirely wanting. In these an attempt may at the same time be made to push back the lens by manipulation of the cornea. The lens may be wounded in an incautiously performed scleral puncture, or the operation may cause extensive intra-ocular hæmorrhage.

An incision through the ciliary body antero-posteriorly has also been recommended. A narrow-bladed Graefe knife is introduced near the corneal margin, usually the upper, and pointed directly backwards, so that its blunt back is toward the edge of the lens. The ciliary body is cut through right up to and against the sclerotic. Though this operation, which has been named *hyposcleral cyclotomy*, sometimes reduces the tension, as indeed any incision near the sclero-corneal junction may, it can do much harm by causing intra-ocular hæmorrhage or inflammation, or by wounding the lens.

Trephining through the sclerotic has been recommended and practised by Argyll-Robertson in cases which seem not likely to benefit by the ordinary operations. The incision is made about the level of the ora serrata by the cutting extremity of a steel cylinder, which is rotated between the fingers. It is extended into the vitreous chamber, so that some of the contents of the latter escape. Subsequent treatment is by wet lint and quiet. The operation is attended with more reaction than iridectomy or sclerotomy, and should therefore, if only on this ground, be deferred in favour of a repetition of these more fully tried methods.

Any of the above described operations may be of benefit by the free drainage that must occur before the reunion of the wound; and, presumably also, by the relief to arteries and capillaries from removal of pressure from the walls of the different venous trunks.

The special beneficial action of iridectomy is due to the removal of a portion of the iris from its contiguity with, or close apposition to, the meshwork of the ligamentum pectinatum. This operation is consequently expressly indicated in cases of inflammatory glaucoma, especially where the anterior chamber is very shallow. It is less suitable to glaucoma simplex generally, and least of all to those long-standing cases where the field of vision is encroached upon nearly up to, or beyond, the fixation-point.

An ample and well-performed iridectomy may be followed by no reduction of tension, or even by an exacerbation. Such cases should be scrutinised carefully, since it is not impossible that the tension may be due to the presence of an intra-ocular growth. It must, however, be remarked that an eye may retain some hardness immediately after the performance of the operation, and yet regain normal tension in the course of a few days. These remarks apply also to sclerotomy.

The way in which this last-named operation reduces the tension is not quite so obvious. It certainly does not act by producing a permeable scar, across which fluid can pass from the anterior chamber to the exterior. More probably a new path is established by which fluid can reach the corneal and scleral lymph-spaces from the retraction of the cut membrane of Descemet (the posterior elastic lamina). However peripheral the operation wound may appear, it is almost invariably found, on post-mortem examination, to be substantially in advance of the ligamentum pectinatum and canal of Schlemm. Sclerotomy is especially indicated in glaucoma simplex, and in those cases where intra-ocular hæmorrhages are likely, such being the hæmorrhagic and very advanced forms of glaucoma, and also the glaucoma of young subjects.

An operation is indicated in all cases of inflammatory glaucoma, except where the perception of light is permanently gone. Its benefit is most doubtful in cases of glaucoma simplex, especially where there is much contraction of field. But it is to be said, even in such cases, that, after a trial of the drugs we have previously discussed, it is the only remedy remaining to us. It is proper to remember that the ultimate effect of an operation is often much better than would appear probable within a few weeks of its performance.

Some cases of glaucoma absolutum cause little or no inconvenience, but others are attended by severe peri-orbital or ocular neuralgia. For this, enucleation is our most sure resource; but, if it be a great object to retain the eye, stretching of the supratrochlear branch of the fifth nerve may be tried. The operation is performed by making a skin-incision, some 10 mm. long, across the track of the nerve as it emerges from the upper and inner border of the orbit. A line drawn from the angle of the mouth through the inner canthus may be taken as a guide to the course of the nerve. It is best to extend the incision at once right down to the periosteum, at the extreme outer and inner ends of the wound, and then to divide or tear through the remaining bridge, bit by bit, upon a strabismus hook. The nerve, which lies very deeply, may be stretched on the hook till it ruptures. This operation has been vaunted by its introducer, Badal, and by others, as a remedy, not only against neuralgia, but also against increased tension. The writer, though admitting that it has undoubtedly some general effect upon the tension, has not found it of real service in ordinary cases of primary glaucoma. It may, however, be employed as a subsequent adjuvant to other operative procedures, and it is undoubtedly useful against the neuralgia of glaucoma absolutum.

W. A. Brailey.

GLEET.—This term is usually applied to the slight and chronic discharge from the urethra, which so frequently follows an attack of acute gonorrhœa. The discharge is, as a general rule, very scanty, just rendering the surface of the urethral mucous membrane moist and sticky, passing away in the early morning in one or more drops of clear or slightly turbid fluid, and in the course of the day barely staining the patient's linen. This condition is sometimes associated with pain at the end of the penis, with slight itching along the urethra, and with a sensation of fulness in the perineum. It is, as a rule, a strictly chronic affection, and in most instances it is a direct continuation of the third stage of gonorrhœa, though occasionally it begins after an interval of two or three weeks from the date of complete disappearance of discharge from the urethra. The general condition in gleet is often faulty, the patient being feeble and pallid, and manifesting a tendency to chronic catarrh. The affection, though characterised by such mild local symptoms, is one of some gravity on account of its persistency, of the mental depression which it often induces, and of the decided and constant tendency in its subject to recurrence of acute inflammation of the urethra. Moreover, it is often indicative of prostatic and vesical mischief, and may be associated with stricture of the urethra.

The diagnosis of true gleet from the gleety discharges associated with hypertrophy of the prostate, old stricture, and warty or polypoid growths in the urethra, may, in most instances, be readily determined by inquiry into the history and clinical features of the case, or by instrumental exploration of the canal. In chronic gonorrhœa the discharge, as was pointed out by Fournier, is always profuse, and decidedly purulent.

The pathological condition, which gives rise to the symptoms of gleet, is very probably a chronic inflammation of the mucous membrane of the bulbo-membranous portion of the urethra. There cannot be any doubt that gonorrhœal inflammation, as it subsides, becomes restricted to the deep portion of the urethra, and has a tendency to persist there in a chronic form. Desormeaux, in his endoscopic researches on gleet, made out a granular condition of the urethral mucous membrane, which he regarded as the special lesion of the affection. According to this surgeon, 'When gonorrhœa passes into a chronic form, the mucous membrane of the urethra at the affected region becomes uneven, and, after a time, presents small hemispherical granulations which are irregularly and sometimes thickly dispersed on a deep red surface. These granulations, which vary much in size, frequently occupy from two to four centimetres of the extent of the urethral canal, and sometimes the whole of its posterior part, from the proximal end of the spongy region to the orifice of the bladder. One almost constant character of this lesion is its continuity. Whether it involve much or little of the urethral wall, there is no interruption between its two extremities, and there are no scattered patches separated by healthy mucous membrane. Sometimes the granulations swell, lose their hemispherical form, become softer, and acquire the aspect of the granulations of a healing ulcer. The affected surface then resembles, in the field of the endoscope, that of a suppurating wound. This ulcerative process may extend still further, and become fungous.' These lesions follow an essentially chronic course, and, Desormeaux asserts, inevitably lead to stricture. *See* ENDOSCOPE.

In the treatment of gleet it is very necessary to attend to the general health. The patient should be put on a plain but abundant and nourishing diet, and be advised to make frequent changes of air and scene, if possible, without going through too active exercise. He should abstain from wine, beer, and tea, and take as drink as much milk as he can digest, with small quantities of whisky or gin in some aërated water. Cold or tepid baths will be found beneficial. The medicinal treatment, unless the urethral discharge be kept up by some diathetic condition, should consist exclusively of one-drachm doses of the compound syrup of phosphate of iron every morning, and from three to five minims of tincture of cantharides, in one ounce of water, three times a day. The local treatment should consist in the introduction, every fourth or sixth day, of a metal catheter of such size as to permit its easy passage along the whole extent of the urethra, and in the daily application of an astringent solution to the posterior part of the canal by means of Tiemann's syringe, or of Harrison's irrigator. The following are some of the most useful injections that have been tried in the treatment of gleet:—Sulphate of zinc (gr. iij. to f℥j.), sulpho-carbolate of zinc (gr. jss. to f℥j.), nitrate of silver (gr. j. to f℥j.), bismuth (ʒss. to f℥j.), tannin (gr. v. to f℥j.), tincture of iodine (♏v. to f℥j.).

In any very obstinate case of gleet, it might be found advisable to apply, as a last resource, blisters to the perineum and the root of the penis. W. JOHNSON SMITH.

GLIOMA. *See* Orbit, Tumours of the; Sarcoma.

GLOSSITIS. *See* Tongue, Diseases of the.

GLUE-BANDAGES. *See* Immovable Bandages.

GLUTEAL ANEURISM.—In cases of aneurism of the buttock, the gluteal is the artery most frequently affected, but the sciatic is not uncommonly involved, and cases are on record where the internal pudic crossing the spine of the ischium, or an abnormal 'sciatico-popliteal' artery has been diseased. To diagnose whether a 'diffused' aneurism implicates the gluteal or the sciatic artery, must always be difficult, and may be impossible; when sacculated, a sciatic aneurism will probably be lower and more deeply situated.

Gluteal aneurisms are spontaneous or traumatic, circumscribed or diffused. In the *spontaneous* variety the aneurism is more likely to be sacculated, and both the vessel itself and the iliacs diseased, than when it is traumatic in its origin; it is often not entirely extra-pelvic, small, deeply-situated, and consequently hard to diagnose. Pulsation and bruit may be detected in the sacculated form, but both may be absent if the sac has given way, and the aneurism has become 'diffused.' Other symptoms met with are pain, not only in the buttock but also along the back of the thigh from pressure on the sciatic nerve, flexion, and some loss of mobility of the limb. The integument may become inflamed from pressure in sitting or some local irritation.

Traumatic aneurisms, which are far the most common, are due to a wound or subcutaneous rupture of the artery. The vessel itself is more likely to be diseased in this latter case; in both the aneurism is probably entirely extra-pelvic; yet this is not necessarily so, for the artery may be wounded before it has passed through the sacro-sciatic foramen, or, when cut across or ruptured, retract within the pelvis.

A traumatic sacculated aneurism will give rise to much the same symptoms as a spontaneous sacculated one; but with the accompanying history of a wound or injury should be easier of diagnosis. The majority of these traumatic aneurisms have, however, no sac except such as is formed by the soft parts; and consequently present themselves as tense fluctuating tumours, devoid of pulsation, in which it may be very difficult or impossible to detect a bruit. Such a one may thus readily be mistaken for a simple blood-tumour, or even, if the integuments are inflamed, for an abscess. Careful search must be made for a bruit, supplemented if necessary by an exploratory puncture before a diagnosis can be arrived at or any treatment adopted. The same precautions must be taken in cases of spontaneous aneurism where the sac has given way and pulsation is absent. In all cases the surgeon should, by rectal examination (and in the female per vaginam also), see if the aneurism is at all intra-pelvic. The condition of the pelvic bones, of the large vessels, and the effect of compression of the latter, may also in this way be ascertained. More details as to the *diagnosis* are given in the article Gluteal Region. It is enough here to say that pulsating gluteal aneurism, especially when spontaneous, has to be diagnosed from pulsating sarcoma of the bone; a non-pulsating aneurism from simple hæmatoma, abscess, non-pulsating sarcoma, enlarged subgluteal bursa, or possibly sciatic hernia.

The *treatment* must depend on whether the aneurism has, or has not, a proper sac, whether it is entirely extra-pelvic, and whether the vessels are likely to be found healthy. In cases of 'diffused' extra-pelvic aneurism, especially when traumatic, the old operation of Antyllus should be performed. It will be found that the sac, such as it is, is much nearer the surface than would have been supposed. In such a case, under the care of the writer, all hæmorrhage, during the operation, was readily restrained by Davy's rectal lever. If this is not used, pressure must be made on the common iliac artery or aorta by some abdominal tourniquet.

In the other forms an endeavour to effect a cure by pressure, under ether, on the large abdominal vessels, either from the rectum or by means of a tourniquet, should be made. Such pressure may be supplemented, when the sac is entire and the circulation commanded, by the use of coagulating injections or galvano-puncture. Pressure from the rectum for any length of time must be made by the hand; Davy's lever could hardly be safely employed for such a purpose. If these means fail to effect a cure, and the aneurism is increasing in size, other measures must be taken. When the swelling is partly intra-pelvic, ligature of the internal iliac may be the only resource left, although this proceeding is both difficult, and dangerous from the likelihood that the vessel itself will be found diseased; when extra-pelvic the old operation is the safer proceeding, or Anel's operation in rare cases may be practicable.

Wound of the gluteal artery is the result of stabs or punctured wounds of the buttock, and it may be uncertain whether it is the trunk, or one of the branches, from which the hæmorrhage proceeds. If this be free and evidently arterial, the surgeon must at once, by enlarging the wound, expose the artery, and tie or twist it on each side of the opening into it. During the operation the rectal lever may be employed; and if the exact source of the hæmorrhage is not to be seen, the pressure should be momentarily relaxed, so that the bleeding may disclose the situation of the wounded artery. If this is intra-pelvic, out of the surgeon's reach, and the hæmorrhage continues, the internal iliac artery must be tied. GEORGE ROBERTSON TURNER.

GLUTEAL REGION.—The skin of the nates, when it is affected with *molluscum fibrosum*, may be much enlarged, loose, and pendulous, from an overgrowth of the subcutaneous tissue: more circumscribed *fibrous* or *fibro-cellular tumours* are also met with. These have a slow painless growth, do not implicate the skin, and, when occurring in the subcutaneous tissue, are freely movable. They are uniform in consistence unless, as sometimes happens, they have undergone cystic degeneration. *Sebaceous tumours*, when small, round, tense, and partially adherent to the skin, are easy of diagnosis; but when larger, may be confounded with *fatty tumours*. Both increase in size slowly, and without pain; but lipomata are lobulated, and often give rise, when compressed, to a characteristic dimpling of the skin over them. They are sometimes congenital. Much more frequently congenital, however, are *nævi*, which, when subcutaneous, form bluish masses, becoming tense when the child cries. They may undergo cystic degeneration, and possibly, if there is no accurate history, be confounded with fatty or fibro-cellular growths.

Gummata may occur in syphilitic subjects, either in the subcutaneous tissue, or more deeply in the substance of the muscles. They form rounded masses, which either yield to treatment, or soften and break down, eventually discharging their contents and leaving an excavated honeycombed ulcer. *Simple* or *hydatid cysts* may also be met with in the muscular substance, giving rise, if the swelling is at all large, to fluctuation. Exploratory puncture will lead to a diagnosis, but this may not be necessary if the thrill peculiar to hydatids is present.

Wasting of the glutei, leading to *flattening of the buttock* and loss of its fold, may result from simple disuse, infantile paralysis, morbus coxæ, congenital dislocation of the hip, sacro-iliac disease, and suppuration of the subgluteal bursa. Wasting from simple disuse is frequently seen where the long splint has been used, or where the limb in some other way has been kept motionless for any length of time. Other muscles than the glutei participate in the wasting, and, if the condition of parts is such as to admit of it, exercise and massage will soon be followed by a return of the muscles to their normal size. In infantile paralysis the onset of the disease is sudden, other muscles are usually implicated, and passive motion of the hip-joint is free; whereas, if disease of this articulation is present, movement, especially abduction and rotation outwards, is painful. The pain is often referred to the knee as well as to the hip, the thigh is flexed, and the joint fixed by muscular action so that the pelvis, which is usually tilted, moves with the femur. In *congenital dislocation of the hip*, which may affect one or both sides, the patient limps and waddles, if old enough to walk. There may be wasting of the muscles, but passive motion of the hip is painless; the trochanter major projects above Nélaton's line; there is shortening of the limb, great prominence of the buttock, lordosis of the lumbar vertebræ, and, if unaltered in shape, the head of the bone may be felt on the dorsum ilii.

Abscess of the buttock may be simple, or due to hip, sacro-iliac, pelvic, or vertebral disease. It may depend on suppuration of the subgluteal bursa, and in rare instances a parametritic abscess may show itself in the neighbourhood of the sacro-iliac joint. An abscess coming from a distance may pass through the sacro-sciatic foramen and present in the buttock. Such a one will be partly reducible, and perhaps have impulse on coughing. When due to *sacro-iliac disease* the formation of abscess has been preceded by muscular wasting, puffiness over the dorsal aspect of the joint, pain whenever the weight of the body is brought to bear on the pelvis or on pressing its walls together transversely; and although there may be lengthening of the lower limb on the affected side from tilting of the pelvis, measurement between the anterior superior spine of the ilium and the malleolus is normal. When due to *hip-disease* its formation has been preceded by the early symptoms of that disease, and examination under ether will very likely disclose erosion of the cartilages and disorganisation of the joint; when due to *vertebral disease* there will be, even if there is no angular curvature, rigidity and pain on percussing the spines of the affected region. The abscess may have passed out of the sacro-sciatic foramen, or be due to caries of the last lumbar or sacral vertebræ. Abscesses *dependent on diseased bone* as a rule do not attain so large a size as when a joint is affected, and, until they burst or are opened, their origin cannot with certainty be determined.

Suppuration of the subgluteal bursa seems to follow blows on the great trochanter, and may in some cases closely simulate morbus coxæ. There may be the same flexion of the thigh, fixation of the pelvis, wasting of the buttock, and immobility of the joint; but under ether the muscular rigidity will subside, and the hip can be moved freely; there is no shortening, no pain in the knee, and the patient can bear pressure, either direct or indirect, on the joint. If the abscess is opened and the finger introduced, the disease will be found to pass beneath the gluteal aponeurosis over the great trochanter. In such abscesses the swelling extends over the upper third and outer part of the thigh, and consequently is on a lower level than that of a gluteal aneurism.

Simple *enlargement of the subgluteal bursa* may appear rapidly without constitutional disturbance, and subside with rest and blistering. If there is any doubt of the diagnosis exploratory puncture may be necessary. A blood-cyst or *hæmatoma* presents as a fluctuating swelling, rapidly following an injury, and may attain a large size in this region. The skin over it is often bruised and discoloured; it may be distinguished from abscess by its more rapid onset and—at least at first—by the absence of inflammation. In doubtful cases exploratory puncture may be necessary. A simple hæmatoma may be confounded with a non-pulsating aneurism, but it has no bruit, is less tense, and has less tendency to increase in size, usually becoming smaller from absorption of the effused blood. Blood-cysts have been known to pass through the sacro-sciatic foramen and present in the buttock.

Gluteal aneurism, when sacculated, presents as a swelling, usually about the size of a hen's egg, at the upper part of the sacro-sciatic foramen, and is accompanied by pulsation, bruit, and, it may be, thrill, together with pain in the buttock and along the course of the sciatic nerve, and often flexion of the limb. Such a swelling can only be confounded with a pulsating tumour of bone; but if the sac has in part given way, or the aneurism has from the first been without a proper sac, without pulsation, but fluctuating and with inflamed integuments, it may readily be mistaken for abscess, but may be distinguished from it by the existence of a bruit. This should be carefully sought for, on more than one occasion, with the patient in different positions. If it be not detected an exploratory puncture should be made before the supposed abscess is incised. *Malignant tumours of bone* have a rapid growth, and are soon accompanied by loss of flesh. They often pulsate, and, even when non-pulsating, they may be mistaken for gluteal aneurism. They are sarcomatous, and may be traversed by bony spicula, or may have an imperfect osseous envelope, and soon, even if they have commenced on the outer, involve the inner or pelvic aspect of the bone. This fact may be elicited under ether by careful examination of the iliac region, and rectal examination of the interior of the pelvis. A gluteal aneurism could hardly erode the bone to such an extent as to present in the iliac fossa. The pulsation of tumour of bone is unaccompanied by the lateral expansion of an aneurism, and the bruit, if present at all, is not so constant, distinct, or harsh, but rather of a soft cooing character. Pressure on the common iliac artery by Davy's lever, so as to command the circulation during the examination of the tumour, might possibly assist in its diagnosis; but the depth and smallness of the gluteal vessel is such as often to make it difficult for the surgeon to decide whether he is dealing with an aneurism or tumour of bone.

Sciatic hernia is most rare, and might possibly be mistaken for aneurism or abscess passing through the sacro-sciatic foramen. It would have impulse on coughing, and, if reducible, re-enters the pelvis with a characteristic gurgle. Even if irreducible, it is still devoid of bruit or pulsation, and probably is in part resonant on percussion. Cases are on record where the swelling disappeared on the patient lying down, to reappear when the erect position was assumed. In one case, where the tumour was large, it had passed down and bulged as a prominent swelling, as big as a fœtal head at full period, at the lower border of the gluteal fold over the upper and inner part of the opposite thigh. On reducing a portion of the contents of the sac the edge of an indurated opening overlying the sacro-sciatic foramen could be felt.

Innocent tumours of the ilium are usually *enchondromatous*. They can be recognised by their slow growth, hardness, elasticity, broad base, fixed position, and evident connection with the bone. They are often nodulated, and perhaps can be felt in the iliac fossa as well as on the dorsum ilii. The diagnosis between them and *fibrous* tumours springing from the bone must be very difficult, if not impossible. An *exostosis* is hard, incompressible, usually sessile, grows slowly and regularly, attaining only moderate dimensions.

A specimen of *hydatid cysts* expanding the walls of the ilium is to be seen in the museum of St. Bartholomew's Hospital.

George Robertson Turner.

GLYCOSURIA. *See* Back and Spine, Injuries of the.

GOÎTRE. *See* Thyroid Gland.

GONORRHŒA.—Gonorrhœa in the *male* is a specific and contagious form of urethritis, producing in its most advanced stage an abundant purulent or muco-purulent discharge. Whether gonorrhœal inflammation ever attacks the mucous membrane of the nose, mouth, external ear, or anus, still remains very doubtful.

In a very large majority of cases gonorrhœa is caused by contagion, and the direct application of gonorrhœal discharge to the male urethra during intercourse with a woman similarly affected. There can be no doubt, however, that urethritis closely resembling gonorrhœa, though perhaps not so acute nor so prolonged, may result from the contact of other morbid discharges from the vulva, and also from excessive irritation of the urethra, through much sexual intercourse, free drinking, violent and continuous catheterism, &c.

Symptoms.—The earliest symptoms of gonorrhœa are usually noticed in the course of the fourth day after exposure: sometimes, though very rarely, they occur as early as the second or as late as the seventh day. The patient complains at first of uneasiness about the meatus, and of slight smarting along the urethra during micturition. At this stage there is often a scanty discharge of clear mucous fluid from the end of the urethra. These symptoms become more marked in the course of the next two days, and are gradually developed into the distinctive signs of intense urethritis. The lips of the meatus are now very red and swollen, the prepuce has become slightly œdematous, and the glans penis is turgid and its surface congested and glossy. The discharge from the urethra is profuse and almost continuous, changing in colour as the inflammation increases, from white to yellow, and in very severe cases to pale green. The whole penis is hot and swollen, and its surface is slightly congested, and in some instances marked along the dorsum of the organ by red and inflamed lymph-vessels. Along the course of the hardened and very tender urethra one or more small swellings, caused by follicular inflammation or suppuration, may occasionally be felt.

The passage of urine over the inflamed mucous membrane of the urethra is attended with intense pain, and at the same time there is constant irritation at the neck of the bladder, and a frequent desire to micturate. At first the urethral tenderness is restricted to the region of the navicular fossa, and subsequently it passes gradually backwards towards the bladder until the whole length of the canal becomes very sensitive. The patient often complains of pain across the lumbar region, and a sensation of heaviness in the pelvis; the perineum becomes very sensitive, and the scrotum and testes may also share in this diffused irritable condition. The inguinal glands are usually swollen and painful, but very rarely suppurate. In this acute stage much suffering is caused by frequent erections, especially when the patient is warm in bed. In consequence of the distension being partial, the penis is bent so as to form an arch with its concavity downwards, and thus presents the very painful condition known as chordee. The acute stage usually lasts until the end of the second week. It is, as a rule, more severe in the first than in any repeated attacks of gonorrhœa. The more intense the inflammation in any attack, the less prolonged is the duration of the acute and painful symptoms of the affection.

In the next stage—that of decline—the urethral tenderness and the pain during micturition gradually diminish, together with all the objective signs of acute inflammation. At the same time the discharge becomes much less profuse and loses its purulent character. The duration of this stage varies much in different cases. In the most favourable attacks the improvement is steadily progressive, and the patient is quite well at about the end of the sixth week. More frequently, however, a clear mucous discharge, together with slight tenderness along the urethra, and frequency of micturition, persists for several weeks or even months. During this period of persistent irritation the patient is very liable to relapse, particularly after imprudence in diet or conduct, or carelessness in keeping up the treatment.

An attack of gonorrhœa is often followed by a condition, more or less prolonged, of imperfect recovery, in which there is a scanty and occasional discharge of pale glairy fluid. This condition, which is seldom marked by any other local symptoms, is known as that of gleet. In some few instances a thick, yellow, and purulent discharge persists for a long time after the disappearance of all other symptoms of gonorrhœa. This Fournier distinguishes from gleet by giving it the name of chronic gonorrhœa.

The form and symptoms of the gonorrhœal attack vary infinitely in different cases. Occasionally the discharge remains as a viscid, clear fluid, and does not become purulent. The inflammation sometimes involves but a small extent of the urethra, and the symptoms do not become severe. In some cases there is profuse discharge and very little pain, and in others much suffering with little, if any, discharge. Some patients recover rapidly from a sharp attack of gonorrhœa, whilst others, notwithstanding care and perseverance in applying treatment, remain subject to a chronic discharge and frequent acute relapses during many months.

There is very little febrile disturbance, as a rule, in gonorrhœa, except the attack be very acute and the patient very feeble, or in cases of serious complication. The painful symptoms of the acute stage cause mental depression and irritability, and the patient suffers from loss of sleep. In cases of profuse and prolonged discharge of pus from the urethra, the patient often becomes slightly anæmic.

As indicated by the sensations of the subject of acute gonorrhœa, the inflammation commences near the external orifice of the urethra, and then spreads backwards towards the bladder, affecting, in its course, the whole extent of the mucous membrane of the straight portion of the penis, but being more intense probably in the region of the navicular fossa. On or about the eighth day, when it may be possible to make an endoscopic examination, the inflammation, according to Desormeaux, has involved the anterior half of the canal, the mucous membrane of which is then red and roughened, and presents superficial ulcerations resembling those formed on the glans penis in balanitis. As the gonorrhœa progresses, the lesion does not change its character but spreads towards the posterior segment of the urethra, involving in succession the bulbous, membranous, and prostatic portions of the canal. Subsequently, as the more severe symptoms of gonorrhœa subside, either the mucous membrane along the whole course of the urethra regains its normal pale colour, or, whilst the anterior and penile portion of the canal and the prostatic portion become quite healthy, the inflammation may persist for some time in the mucous membrane of the membranous and bulbous regions, and there give rise to the granular formations which, in the opinion of Desormeaux and Cruise, constitute the characteristic lesion of gleet.

Complications.—The following are some of the most frequently observed complications of gonorrhœa: phimosis and paraphimosis, due to œdema or serous infiltration, in the one instance of an elongated, in the other of a short prepuce; retention of urine, which, however, is rare except in subjects of organic stricture; follicular suppuration at one or more points of the urethral mucous membrane; circumscribed phlegmon and suppuration of the erectile tissue of the penis; inflammation of the lymph-vessels of the penis, and of the inguinal glands; perineal abscess; inflammation of Cowper's glands; sub-acute inflammation of the glandular tissue of the prostate; congestion or inflammation of the neck of the bladder; epididymitis. The last-mentioned complication presents a transition form between the above group and that of the more remote affections, such as gonorrhœal rheumatism, purulent conjunctivitis, and the so-called metastatic ophthalmia.

Hæmorrhage from the urethra is an occasional complication of gonorrhœa. In the acute stage of a gonorrhœal attack, blood is almost always effused in small quantities, and causes the green staining so often noticed in the purulent discharge. In instances of the rare form of *menstruiform gonorrhœa* described by Ricord, and of extreme congestion of the prostate and neck of the bladder, blood is mixed more freely with the discharge, so as to give it a decided pink or red colour. True urethral hæmorrhage, consisting in a flow of unmixed bright red blood, usually takes place in small quantities, but in some cases is so abundant and persistent as to create anxiety. The cause of this bleeding from the urethra is generally some laceration of the wall of the canal, or rupture of one or more vessels, during severe and sudden chordee. It readily yields, in most instances, to the application of cold cloths to the penis and pressure on the perineum. If very profuse, it may be found necessary to pass a large metal sound along the urethra.

For descriptions of the sequelæ of gonorrhœa, of which gleet, urethral stricture, and chronic cystitis, are the most important, and also of many of the abovementioned complications, the reader is referred to special articles.

Treatment.— But very little need be said here of the substitutive, or so-called abortive, treatment of gonorrhœa, in which an attempt is made to cut short the attack in its first stage, by setting up, in place of the specific gonorrhœal inflammation, a simple form of inflammatory action readily amenable to ordinary therapeutic means. With this object in view, some surgeons have applied strong solutions of irritants or of astringents to the urethral mucous membrane, and others have administered internally large and frequently repeated doses of balsamic remedies, such as copaiba and cubebs. The free use of balsams is not only useless as a preventive means, but is likely, as has been pointed out by Mr. Henry Lee, to cause much constitutional disturbance; and the local application of nitrate of silver, in strong solution, as recommended by Debeney, Diday and Carmichael, is very liable to result in serious and enduring mischief, and to prove worse than the disease. In the very rare instances in which gonorrhœa is met with while still in the first stage, much good may be done by associating with rest, and a general lowering treatment, frequent irrigation of the urethra with a warm and very weak solution of boracic acid, or of sulphurous acid (♏xv. to f℥j.), or of bichloride of mercury (gr. j. to f℥j.), or one injection daily of a weak solution of diacetate of lead (gr. ij. to f℥j.).

The treatment of gonorrhœa in its acute stage is, in most cases, rendered very difficult simply through the inability of the patient to remain at rest for a sufficient time, or from his disregard of instructions as to diet and general conduct. During this stage, he should, if it be possible, maintain almost constantly the recumbent posture, resting on a hard mattress at night, and on a couch during most of the day. The diet should be low, and consist almost exclusively of milk, eggs, and dry toast. Malt liquors, wine and spirits, and even tea and coffee, must be scrupulously avoided, and the patient should take, when thirsty, barley-water, or some effervescing alkaline drink, as soda, seltzer, or Apollinaris water. The bowels should be promptly relieved by some very active cathartic, and be kept open by a daily morning draught of Epsom salts, or of Pullna or Friedrichshalle water. In the course of the day some alkali should be frequently administered, with the object of reducing the acidity of the urine, and of relieving irritation of the urinary organs. The most effectual of alkaline remedies, during the acute and inflammatory stage of gonorrhœa, are the salts of potash; either the acetate or nitrate, in eight-grain doses, or the citrate in half-drachm doses, may be given with much benefit, every three or four hours, in association with half a drachm of spirits of nitre, and fifteen minims of laudanum or a drachm of tincture of henbane, in one ounce of water.

If the gonorrhœal inflammation be so intense as to cause febrile disturbance, a small draught of five minims of liquor potassæ and two minims of tincture of aconite to a teaspoonful of water, given every hour, will often do much good. If irritation of the genital organs and a constant tendency to erection be the most prominent symptoms of the acute stage, a draught containing fifteen or twenty grains of bromide of potassium, and five minims of liquor ammoniæ acetatis, should be administered every four hours. The patient, unless he be very feeble, should take a warm bath once or twice in the day. The best local treatment, during this stage, is the simple and very useful plan of applying very hot water to the penis.

For the treatment of chordee, many remedies, most of them of very uncertain action, have been recommended from time to time. The most promising is camphor, given at bed-time, in a large dose. Lupulin, bromide of potassium, ergot of rye, belladonna, and opium are each worthy of trial. A very efficacious remedy is a suppository containing a grain of opium and three grains of camphor. In a case of very painful chordee, the best treatment probably, if the patient be strong and vigorous, is for him to have a warm bath just before going to bed, and then, after having taken a drachm of tincture of camphor in an ounce of water, to rest, lying, as far as may be possible, on his side, and very lightly covered.

On the subsidence of the acute inflammatory symptoms, and when the pain, during micturition, has been much relieved, it becomes necessary to vary the treatment. The diet may now be extended, but the patient must still be forbidden to take beer or wine. Continuous rest, also, is no longer necessary, though, of course, active exercise and much standing must be avoided. In this, as indeed in any stage of gonorrhœa, smoking is decidedly injurious, and, as has been insisted on by Dr. Bumstead, entire abstinence, or, at least, much moderation with regard to this habit, should be observed during the treatment.

In dealing with this stage of a gonorrhœal attack, the surgeon trusts mainly to the use, either combined or independent, of balsamic remedies and urethral injections. Of the former agents the best known are copaiba and cubebs. Copaiba is usually given in doses of from half a drachm to two drachms in the form of mixture or pill, or in capsules, and the average dose of cubebs is one drachm. Each of these remedies acts directly on the mucous membrane of the urethra, as it is excreted with the urine, after having undergone some change in the organism. The use of a balsamic remedy is indicated on cessation of pain during micturition, and when urethral tenderness and swelling and congestion of the glans penis have subsided. The selected remedy should be administered regularly, and four times at least in the twenty-four hours; and with respect to meals, one hour before or three hours after each. As a rule these remedies act tardily, and it is necessary, therefore, if no general disturbance is caused by their action, to persevere in their use for several weeks, combining with each, if there be any indications for such agents, tonics or sedatives. There can be no doubt that these remedies, if properly administered at the proper season, are very beneficial agents in the treatment of gonorrhœa; and that failure of a prolonged course of either is generally due to such causes as would neutralize the action of any other method. Copaiba, however, often causes much gastric disturbance and diarrhœa, and occasionally renal irritation: cubebs, it has been stated, may give rise to headache and nervous symptoms, and both remedies are extremely unpleasant to the taste and apt to cause nausea. The most valuable, probably, of the anti-gonorrhœal balsams is the oil of yellow sandal-wood. This is usually more rapid in its action than copaiba, far less unpleasant, and is not so liable to cause nausea or to affect the stomach.

It is very unadvisable to administer any balsam before the acute inflammatory symptoms have commenced to subside, and the remedy should be promptly withheld in case of any relapse during the period of decline. Whether speedy or slow in producing good results, the remedy, if tolerated by the system, should be given for at least a fortnight after the cessation of the urethral discharge. During a balsamic treatment, the patient should avoid taking fluid in abundance, lest the balsam, as it is discharged in the urine, be too much diluted. The agent that is selected, be it oil of sandal-wood, or copaiba or cubebs, if it does not cause any gastric or other disturbance, should be given a fair trial, and it will be found better to give each remedy singly than in combination with either of the others.

The following agents have been given in the third stage of gonorrhœa with such success as to justify a trial of any one in case of failure or contra-indication of the above-mentioned balsamic remedies: turpentine (♏ x.), Canada balsam (gr. v. in pill), infusion of uva ursi (f℥j.), tincture of perchloride of iron (♏x. to xx.), citrate of iron and quinine (gr. v.).

Astringent injections, when used with much precaution, are certainly beneficial in the passive stage of gonorrhœa when all inflammatory symptoms have disappeared. As, however, in the majority of instances, they are liable to be administered irregularly and without proper care, and may excite epididymitis, renewed urethritis and peri-urethral abscess, it will be found advisable, as a general rule, not to have recourse to this method of treatment unless balsamic remedies, after full trial, have failed or proved prejudicial. As some of the most useful of the many agents that have been used in injections may be mentioned: nitrate of silver (gr. ij. to f℥viij.), sulphate of zinc (gr. j. to f℥j.), chloride of zinc (gr. j. to f℥j.), sulpho-carbolate of zinc (gr. ij. to f℥j.). A very useful injection is that known as Ricord's combination of sulphate of zinc and actetate of lead (gr. v. of each to f℥j. of water).

The urethra having been injected with warm water, and the purulent discharge washed away, about half an ounce of the astringent injection should be slowly introduced, and be retained in contact with the urethral mucous membrane for about five minutes. Two, or, at the most, three injections should be given in the twenty-four hours. During a course of treatment by injection, the patient should take care to avoid irritating the genital organs by active exercise, imprudence in diet, or sexual excitement. If blood appear in the discharge, or micturition become frequent and painful, the use of injections should at once be discontinued.

An antiseptic treatment, based on the assumption of a parasitic origin of gonorrhœa, has been strongly advocated by Mr. Watson Cheyne, who recommends the use of soluble bougies containing eucalyptus and iodoform, with a view of arresting, or at least checking, the acute inflammatory symptoms. W. Johnson Smith.

GONORRHŒAL EPIDIDYMITIS.

See Testis, Diseases of the.

GONORRHŒAL OPHTHALMIA.

See Conjunctiva, Diseases of the.

GONORRHŒAL RHEUMATISM is an inflammation of the joints or fibrous structures, dependent upon discharges from the genito-urinary organs. The most frequent cause is gonorrhœa, which may be in the acute or chronic stage. The disease may also be set up by any form of urethritis, or even by a balanitis, and in women a closely allied condition is apt to accompany obstinate leucorrhœa. In infants, as Mr. Lucas has recently shown, ophthalmia neonatorum may give rise to a similar affection. There are three well-marked varieties of this disease—viz. (1) an acute, (2) a chronic inflammation of the joints, and (3) an inflammation attacking non-articular fibrous tissues.

Symptoms and cause.—1. The *acute articular* form begins with slight feverishness and pains in several joints, which are somewhat swollen and tender. In a few days the inflammation appears to concentrate itself upon one of these joints, while the others recover. The swelling and tenderness increase; the tissues covering the joint and the adjacent parts of the limb become œdematous, and the skin is often reddened. There is acute pain, which is much increased by any attempt to move the limb. The tenderness is especially noticeable when pressure is made upon the stronger ligaments of the joint. Thus, when the elbow is attacked, the parts below the condyles of the humerus are excessively sensitive on account of the inflammation in the lateral ligaments. There is usually some serous effusion into the synovial cavity. The joints affected are almost invariably the larger ones, and especially the elbow and wrist. The patients are usually young adults, and the writer has seen more instances of the affection in women than in men. The discharge from the genital organs may be slight, or even a mere gleet. It does not appear to be diminished or otherwise affected by the outbreak of the joint-inflammation. The temperature is usually but little raised, and there is not much constitutional disturbance. The patient, however, is often anæmic and feeble, and the local pain, by interfering with his appetite and sleep, is apt to increase this debility. In the great majority of cases the disease gradually subsides, and leaves the joints in a more or less rigid condition. In rare instances the joint may suppurate and become disorganised. Occasionally other joints are successively attacked. The disease may recur with a subsequent gonorrhœa.

2. A *chronic articular* form of the disease is perhaps not more frequent, but it is certainly more often recognised. It appears as a sub-acute inflammation of the synovial membrane, which attacks especially the knee and ankle-joints of men. There is serous effusion into the synovial capsules, without any redness of the skin cr superficial œdema. The pain is of a dull aching character, and does not prevent the patient getting about, in a more or less crippled condition. Two or more joints are often simultaneously affected. The disease is very obstinate, and it is liable to frequent exacerbations. It never suppurates.

3. A chronic or, in rare cases, an acute inflammation may attack the *non-articular* fibrous tissues, such as the fasciæ of the muscles, the annular ligaments, the sheaths of nerves, &c. It is attended by some swelling and tenderness, with severe pain in the affected structures, which are sometimes so softened as to allow of considerable yielding. Thus when the plantar fascia is attacked, the arch of the instep may fall in, and a flat foot may be produced. The sclerotic coat of the eye may be the seat of such an inflammation, indicated by a peculiar congestion which may accompany the acute or chronic form of joint-disease. Occasionally also the fibrous tissues of the heart are attacked, and valvular lesions have followed this complication.

Pathology.—The disease is probably of a pyæmic character, depending upon the absorption of inflammatory products from the genito-urinary tracts. Some writers, however, have attributed it to innervation, and have considered that the inflammation is set up by reflex action of the nerve-centres under the stimulus of the local irritation. In the acute form of joint-disease the fibrous tissues are especially affected, and they are frequently so much softened as to permit of abnormal movements. There is often fibrinous exudation within the articular cavities, and the cartilage may be eroded, so that a rough or even grating sensation may be felt upon moving the joint. Adhesions are also formed in the peri-articular regions, and in the sheaths of the adjacent tendons.

The more chronic form appears to affect the synovial membrane, without any serious implication of the other structures of the joints.

Diagnosis.—The chronic forms are easily recognised. They resemble gouty or rheumatic synovitis, but the presence of the urethral discharge suffices for their discrimination. The acute form is at first very like a mild attack of rheumatic fever. Afterwards, when one joint is alone affected, it may assume an appearance similar to that of phlegmonous erysipelas, phlebitis, or acute suppuration of the joint. The discharge from the genital organs may be slight, and there is usually a disposition to conceal its presence. From overlooking this symptom serious mistakes have often been made. Frequently the red and swollen tissues have been incised under the idea that pus has formed. It is therefore wise in all cases of acute idiopathic inflammation of a single joint to examine into the condition of the genito-urinary organs.

Treatment.—By the use of astringent and soothing injections the urethral or vaginal discharge should be cured. In the acute form the joint should be kept at perfect rest, with gentle pressure and some anodyne application. Lint spread with a mixture of equal parts of ung. hydr. comp. and extract of belladonna should be wrapped round the joint, and a plaster of Paris bandage applied over all. As ankylosis may occur, the joint should be placed in the most useful position. As soon as the acute symptoms have subsided passive motion should be employed, and the still swollen joint should be supported by an india-rubber bandage applied over the greater part of the limb; or the limb should be swathed with five or six layers of cotton-wool, and then firmly compressed by a starch bandage. In the more chronic form this latter treatment is also beneficial, as it permits the patient to move about freely and to follow his ordinary occupation. Blisters or stimulating liniments may often be required for the cure of this obstinate form of the complaint. When the pain is severe the local application of some anodyne, such as the extract of belladonna, may be necessary.

Attention should be paid to the general health. A nutritious diet should be given, and the bowels should be relieved by gentle purgatives. But little benefit is obtained from the use of alkalies, iodide of potassium, salicylate of soda, or the other remedies for rheumatism. Some tonic preparation, such as a combination of quinine and iron with mineral acid, is usually more beneficial.

N. Davies-Colley.

GOOCH'S SPLINT consists of flat boards, about one-eighth of an inch thick, glued on to oilcloth or leather, and split into parallel strips about one-third of an inch wide by longitudinal incisions, which do not completely divide them. It is flexible in one direction and quite rigid in the other. It is a very useful material to have at hand for extemporising splints from, as it can be readily cut to the required shape and size with a knife. Its transverse flexibility renders it most comfortable to the patient, whilst its longitudinal rigidity fulfils the needs of the surgeon. It is the best material for stump-splints and short thigh-splints for fractures of the femur treated by simple extension; but it may be used, and is by the Scotch surgeons, for almost all regions.

Bilton Pollard.

GORDON'S SPLINT FOR COLLES' FRACTURE consists of an anterior splint, to the radial side of which is fixed a wooden pad shaped so as to fit the concavity at the lower end of the radius. From the lower end of the splint there is a prolongation adapted to receive the ulnar border of the hand in the adducted position. There is also a slightly hollowed dorsal splint, which is placed over the back of the forearm and dorsum of the hand.

Bilton Pollard.

GORDON'S SPLINT FOR FRACTURED CLAVICLE consists of a body-plate and an artificial clavicle or rod passing from it to a front arm-splint; to the anterior border of the latter a second arm-splint is attached. The splints are fixed in position by a complicated system of straps. The objects of the splints are to rotate the shoulder outwards and backwards, and maintain it in that position until union of the fracture has taken place. No attempt at elevation of the shoulder is made, as the author of the splint considers that the shoulder is not really depressed, and that pushing the shoulder upwards, backwards, and outwards would increase the deformity.

Bilton Pollard.

GORGET. *See* LITHOTOMY.

GRAFTING.—SKIN-GRAFTING.—Many large granulating surfaces, though at first healing with considerable rapidity, afterwards do so slowly, and the process may even come to a standstill owing to the resistance of the surrounding tissues to the further contraction of the granulations, and also probably on account of the attenuated condition of the epithelial cells at the border of the sore. In such cases in time past, flaps, including the entire thickness of the skin, were occasionally taken from another part of the body, and placed on the granulating surface; but this process, besides being painful, and leaving a large sore at the spot from which the flap was removed, was in so many instances attended with failure, that it was seldom resorted to. M. Reverdin of Geneva introduced the present method of skin-grafting. In 1869 he succeeded in transplanting small portions of skin from one part of a man's body to a granulating surface situated at another, and thereby greatly hastened the healing of the sore. This method has been widely adopted, and is now regularly employed to facilitate the healing of large granulating surfaces, such as may have been left by ulcerative processes, occasioned by large burns or by wounds involving an extensive destruction of the cutis. It is also of considerable value in obviating deformities, such as ectropion arising from contractions due to cicatrisation.

A granulating surface is covered with epithelium by segmentation or budding of the epithelial cells at the margin of the sore. These cells cannot arise from granulation-tissue, but must have origin in some pre-existing epithelium. If then minute portions of skin be transplanted on the granulation-tissue, the proliferation of the cells of these grafts leads to the formation of cuticular islands, which go on increasing until they coalesce with one another, or with the epithelium from the margin of the sore. By doing so the healing is greatly facilitated, and the process of repair is rendered much more complete and permanent.

The transplanted graft ought to consist of some of the protoplasmic cells of the rete. The Malpighian layer is supposed to be necessary, but any of the cells of the stratum granulosum, and even the deeper cells of the stratum lucidum, the writer considers quite sufficient for the purpose. The stratum cornium is of no value; neither does it serve any purpose, if indeed it does not hinder the process, to include the subcutaneous tissue. Practically, all that is necessary is to remove a minute superficial portion of the skin. This may be done in a variety of ways. The dissecting-forceps may be made to pinch up, or a needle to transfix, a small portion of the skin, which may be snipped with scissors or removed with a scalpel. A special instrument, a combination of scissors and forceps, is made by Krohne after Macleod's pattern, for effecting the removal of such portions of skin. The writer finds that a pair of sharp scissors curved on the flat is well adapted for raising a thin shaving of the cutis. The surface from which the skin is removed presents a reddened appearance, with at times a few minute points of blood. It may be covered for a few days with a small portion of protective oiled silk or other simple dressing, or better still dusted with iodoform, which stops the bleeding and acts as a good dressing.

When the portion to be grafted has been elevated, it is divided into as many minute particles as practicable: pieces the size of an ordinary pin's head are suitable. This may be done by means of a sharp knife, the finger-nail being used as a table. These grafts may be placed at any part of a healing granulation-surface, and may grow there, forming islets of skin. But all parts of a granulating sore are not equally prepared for the reception of a cuticular covering. Thus, at the centre of a healing sore the granulations are prone to be larger and the secretion more profuse than towards the margin, where they are at the proper level of the skin, and where the secretion is reduced to a minimum. Therefore if the grafts are placed within three-quarters of an inch of the margin of the ulcer, they will find a tissue suitable for their reception. They may be placed about an inch apart from each other. Not only is this zone of tissue more suitable for the grafts, but by their presence here, they seem to exercise a beneficial influence on the cutis at the margin of the sore itself; as, shortly after the grafts have become adherent, the marginal epithelium seems to be stimulated to more vigorous growth than formerly. The grafting may be repeated as often as required.

The grafts ought to be placed in intimate contact with the granulation-tissue, and retained in position by some convenient dressing. Some surgeons recommend that a wound be made in the granulation-tissue, and that the grafts be inserted into it. This is not advisable, but care is required to prevent the grafts from being displaced, which may happen in one of two ways: first, by friction from the outside, and, secondly, by being floated from the granulations in the discharge. The means taken to obviate the former often facilitate the latter. If the sore be large, and a single piece of guttapercha tissue, or other waterproof material, be laid over the grafts in contact with the granulation-tissue, the secretion from the whole surface accumulates under the dressing, and is apt to float the grafts before they have become sufficiently adherent. The writer finds that a piece of freely perforated oiled silk or protective plaster, laid on the grafts and covered with sublimated wood-wool, is admirably suited for the purpose. The silk protects the grafts from injury, and as it does not adhere, there is no tendency to displacement of the grafts, while the numerous apertures in the oiled silk permit the secretion to come into contact with the sublimated wood-wool, which, being an excellent absorbent, the wound is kept dry, the necessity for frequent dressing is dispensed with, and the healing is facilitated. A week afterwards the wound may be dressed.

The superficial layer of the grafts sometimes separates, and is seen floating in the secretion while the deeper layer has united to the tissues. If this be not borne in mind when the surface of the granulation-tissue is being examined in order to ascertain whether the grafts have taken, it might lead one to suppose that they had failed. This mistake is all the more probable on account of the fact that the young epithelial cells are so transparent that they are barely recognisable, the granulations being seen through them, and therefore at an early stage they might be easily overlooked. The newly transplanted skin assimilates itself so thoroughly to the tissues that it soon becomes sensitive, and the cicatrix formed by its aid resists disintegrating changes much better than when unaided cicatrisation has taken place over a large surface.

In dealing with ulcers it is essential that all molecular disintegration should have ceased at the part on which the graft is to be placed. Occasionally skin-grafts do succeed when planted on granulations which are not quite in a state of health, and when this is accomplished they speedily effect an improvement on the granulations surrounding them. Though this be admitted, there can be no doubt that skin-grafting is most easily effected, and most successful when performed on a healthy granulating surface. As the condition of the ulcer depends greatly on the state of the patient's constitutional condition, the general health ought to be closely looked to.

The parts of the body from which grafts ought to be taken are those least exposed to friction, and which are at the same time not covered by a thick cortical layer. It is best to take the graft from the body of the patient for whom it is required. By doing so, the fear of introducing deleterious or poisonous elements into the blood is avoided. A mother might prefer to have the graft removed from her own arm for the sore on her child. If the graft is to be removed from another person, sanction ought to be sought and distinctly received before doing so. Although the epithelium is being constantly renewed during the whole life of the individual, yet in old age its vitality is somewhat impaired, and it is not so suitable for grafting as that of a young person. In a hospital, skin may be taken from a newly amputated limb—the sooner after removal the better, though the epithelium has been known to have retained its vitality for an hour after amputation, and to have lived on being grafted.

Transplantation of conjunctiva has been frequently successful. The transplants have been taken from the conjunctiva in the lower animals, and applied to the eyeball in man. The epithelium from the mucous membrane of the lip has been likewise used for this purpose, it is said with success. The cornea has been in a few cases transplanted; on one occasion at least it has been temporarily successful, the part remaining transparent for a considerable period, and only becoming opaque afterwards from an inflammatory attack.

Muscle and nerve have been transplanted, but the data given are not sufficient to warrant any practical deductions therefrom.

BONE-GRAFTING.—Under this heading some include several distinct processes, re-implantation of bone, osteoplasty, and bone-grafting. The first of these consists in the replacement in its original position of a portion of bone temporarily removed by operation or by accident; such as the reimplantation of a disc of bone elevated by trephining the skull. In osteo-plastic operations, a portion of bone is detached, so that its osseous continuity is either wholly or partially severed, while its attachment to the soft parts from which its vascular supply is derived still remains more or less complete. This is illustrated when one endeavours to fill up a deficiency in a long bone by detaching and shifting a portion of bone from the shaft in the immediate vicinity of the gap, while a pedicle of periosteum, or of the soft tissues, is left adherent at one extremity of the detached portion of bone. Neither of the foregoing should be properly included under the heading of bone-grafting, that term being reserved for such operations as involve the introduction of a portion of bone into the tissues altogether removed from its original seat, or of transplantation of osseous tissue from one animal to another.

Though in times past many attempts have been made to graft bone, or some of its elements, they have not been attended with practical success until within recent years. In a paper published in the *Proceedings of the Royal Society* in May, 1881, entitled 'Observations concerning Transplantation of Bone,' the writer referred to a case which he had of successful and extensive bone-grafting. The grafts in this instance were obtained from six limbs of three children who had to be operated on for tibial anterior curvatures, and a wedge of bone was removed from each limb. The grafting was performed on three separate occasions, two wedges being transplanted at one time. These wedges were divided into minute fragments, irrespective of periosteal attachments, and were placed in a sulcus made between the humeral muscles of a boy who had lost his humeral diaphysis more than a year previously. By these numerous grafts the two epiphyses were united together by a firm shaft, and the use of his arm was fully restored.

It is stated that bone cannot be transplanted from one species to another, and though definite proof to the contrary is wanting on this point, the writer has reason to doubt the accuracy of the statement. The best osseous grafts are obtained from young growing bone. Human bone may be obtained in hospitals from limbs which have been removed on account of accident or disease. In cases of anterior curvature of the tibia, causing marked deformity, and which demand straightening, it is often necessary to remove a wedge therefrom, and such wedges may furnish the material for grafting. The preservation of the periosteum is not essential to the success of the graft; it is important to preserve it, however, owing to the fact that in young bone it protects the underlying osteoblasts, and forms vascular connections with the tissues into the midst of which it is transplanted. Many portions of bone, even of the deeper layers, and those occupying a position midway between the medulla and the cortical substance, grow well when transplanted. After removal of the bone, it ought to be divided into minute fragments about the size of a pea. In doing this the fragments ought not to be broken or crushed, but cleanly cut. If the bone about to be taken for the graft be thin and vascular, it may live and grow in its transplanted situation without having been so minutely subdivided. Discs removed from the skull, when they are young and vascular, have grown when reimplanted after operation.

When an osseous graft is about to be effected, the part into which the graft is to be placed ought to be first prepared. The extremity of the bone, to which the graft is to be attached, ought to be refreshed, and the aperture between the muscles made of sufficient size to receive the osseous fragments without over-distension. After all bleeding has ceased, the part is ready for the reception of the grafts. The portion of bone to be transplanted ought then to be struck out of its normal position with a sharp chisel, and cut into small pieces, immediately thereafter placed in the sulcus prepared for it, and the soft parts closed over it. The entire operation ought to be performed under strict antiseptic precautions. The limb ought then to be fixed and kept at absolute rest. If healing by first intention is obtained, the parts ought to be tolerably firm at the expiration of a month, though it is better to maintain complete rest for six weeks or two months from the date of operation. On this point, however, something will depend on the extent of the graft employed, a small one becoming firm sooner than an extensive one. If suppuration follows, some portion of bone will be thrown off, and if the inflammatory process be great the whole graft may be shed. One of the chief points in securing success is obtained when the wound heals without suppuration.

The grafting of periosteum and of the medulla of bone have both been experimentally successful in the lower animals; but the data derived from these observations are neither so clear as to warrant definite conclusions being formulated from them, nor sufficient to establish their practical utility. It is difficult to see in what way either of these elements would equal the efficiency of bone-grafts for practical purposes.

SPONGE-GRAFTING.—With a view of expediting the healing of deep wounds in which there has been a loss of tissue, Dr. Hamilton of Edinburgh introduced the practice of what he called 'sponge-grafting.' The sponge to be used is previously prepared by steeping it in dilute nitro-muriatic acid, to dissolve the silicious and calcareous salts; and when this has been effectually accomplished, the sponge is washed in dilute ammonia or potash, to remove all excess of acid. It is then placed in a 5 per cent. solution of carbolic acid, to render it aseptic, and it is stored in the same until required. A thin section of sponge prepared in this way, Dr. Hamilton recommends to be placed over such granulation-surfaces as are below the level of the skin, with the view of affording a support for the blood-vessels of the granulation-tissue which would push their way into the interstices, and so fill up the cavity, the sponge eventually becoming absorbed. He further recommends that, when one piece of sponge has been covered by granulations, another may be applied on the surface until the granulation-tissue reaches the proper level. Dr. Hamilton relates cases in which he believes that this process hastened the healing of the sores, and a few cases have been reported by other surgeons, all of them tending to prove that the so-called 'sponge grafting' is a successful means of healing such sores. The writer has carefully experimented in this direction, and, however interesting as a physiological phenomenon the penetration of the decalcified sponge by granulation-tissue may be, his observations have not led him to believe that the sponge hastened the healing of the sore, while in some instances it distinctly retarded it.

William Macewen.

GRANULAR OPHTHALMIA. *See* Conjunctiva, Diseases of the.

GRAVES' DISEASE. See *Exophthalmic Goître*, under Thyroid Gland.

GREENSTICK FRACTURE. *See* Fractures.

GROIN.—The groin is the site of many important injuries and diseases, forming as it does the junction of the abdomen, pelvis, and thigh; and being the seat of four forms of hernia—inguinal, femoral, obturator, and ventral—and of many varieties of abscess and tumour.

Stretching between the anterior superior spine of the ilum and the pubic spine is Poupart's ligament. Below this is a hollow, corresponding superficially to Scarpa's triangle in the dissected part. Beneath the ligament is the pubic bone; and between the two, passing from the abdomen to the thigh, are the psoas and iliacus muscles; the femoral artery and vein; the anterior crural, the crural branch of the genito-crural, and the external cutaneous nerves.

Deeper than the horizontal ramus of the pubic bone, and under the pectineus muscle, is the opening whence obturator hernia escapes from the pelvis. Above Poupart's ligament is the inguinal canal, with the internal ring half an inch above the middle of Poupart's ligament, and the external ring above and internal to the pubic 'spine.' The femoral ring is immediately below and external to this bony process. The inguinal canal is concerned in hernia, various forms of hydrocele, undescended testicle, misplaced ovary, varix and fatty tumour of the cord. The superficial fascia over the groin is disposed in two layers—the subcutaneous fatty, and the deeper membranous, the latter being firmly attached to Poupart's ligament.

An inch and a half below and external to the pubic spine is the saphenous opening. The crural sheath has three compartments: the outer, lodging the femoral artery; the middle one, the vein; and the innermost —called the crural canal—a pellet of fat and a lymphatic gland. Femoral hernia occupies the last-named space. Between the layers of the superficial fascia are some blood-vessels, and lymphatic glands and vessels. The lymphatic glands of the groin are arranged in two primary sets, superficial and deep. The former consist of a horizontal series along Poupart's ligament, and a vertical in Scarpa's triangle. The deep set lie in the crural sheath beside the vein. A bursa lies between the ilio-psoas muscle and the capsule of the hip-joint. It may communicate with the synovial membrane of the articulation.

In the diagnosis of diseases and injuries of the groin it is important to determine whether the lesion is entirely confined to the part, or is connected with some other region either by continuity of solid tissue, by lymphatic vessels, or by a wider channel, as in psoas abscess and hernia. Immediate localisation is a further aid in estimating the nature of a given case; thus, a swelling above Poupart's ligament is suggestive of an enlarged gland, an undescended testicle, funicular hydrocele, and thickening of the cord.

Isolated nodular elevations of the skin indicate enlargement of the subjacent lymphatic glands. Nodulation *en masse* points to a conglomeration of swollen glands, or to a lobulated tumour.

Congestion of the skin shows that the circulation in it is impeded. If the redness is diffused, it may be concluded that the morbid process has involved the skin. Distension of the cutaneous veins proves that there is deep-seated obstruction from compression or plugging of blood-vessels.

Flexion of the thigh is common to all painful affections of the groin. *Fixed rigidity* in this position is generally due to hip-joint disease, or deep-seated suppuration from any other source; it shows that the soft parts have undergone atrophic shortening. *Transient flexion* is entirely owing to spastic contraction of the muscles. Taken alone it is of little use in diagnosis, as it may be caused by a variety of pathological states. It disappears under the influence of an anæsthetic.

A pulsating tumour in Scarpa's triangle is probably an aneurism, or a vascular malignant growth; possibly a solid or fluid swelling, with pulsation communicated from the femoral artery.

If the tumour, after being emptied by compression, refills suddenly with a thud, and the bruit, when present, is conducted for some distance along the main artery, and the pulsation is markedly expansile, it is an aneurism. But when an aneurism is largely filled with clot, especially if it has ruptured, and the swelling is thereby more diffuse, its density is greater, whilst the bruit and thrill may be abolished and the pulsation reduced to a minimum. Attention must then be directed to the previous history of the case. The pulsation of a malignant growth is constant and progressive. Dilatation of other arteries would afford a strong presumption in favour of aneurism.

Dilatation of the superficial veins, with pulsation, bruit, and thrill, are the signs of *arterio-venous aneurism.*

A swelling which has previously pulsated, and subsequently become red and painful, is probably an *aneurism with inflammation or suppuration about the sac.* It must not be mistaken for an abscess with communicated pulsation. To avoid this, the various sources of abscess-formation should be carefully explored.

A non-pulsating, reducible swelling, giving an impulse on coughing, is either hernia, abscess—psoas, e.g.—or varix. If it is resonant on percussion, elastic, and *suddenly* reducible under pressure, it is *hernia.* The exact nature of the rupture is told generally by the situation of the swelling, and especially by the position of its neck. Thus if the hernia be limited above by Poupart's ligament, it is either femoral or obturator; if bounded below by that structure it is inguinal or ventral. The elasticity and resonance on percussion differentiate an inguinal hernia confined to the canal, from an enlarged gland or swollen undescended testicle; whilst resonance on percussion and sudden reduction by pressure distinguish it from encysted hydrocele of the cord. If the neck of the hernia lies immediately above and internal to the pubic spine, the rupture is inguinal. The neck of a femoral hernia is situated just outside and below the pubic spine. It is very important to note this fact, because it is not uncommon for a femoral hernia, after it has escaped from the saphenous opening, to turn upwards over Poupart's ligament and so simulate an inguinal rupture. In such cases the swelling passes outwards as a rule, but it may travel inwards and completely overlap the external abdominal ring.

Roundness of contour is suggestive of a femoral hernia, whilst an oval outline is presumptive evidence of a bubonocele.

A small, hard, tender, and painful swelling, at the site of the crural canal, is either an *inflamed lymphatic gland* or *a femoral hernia.* Palpation alone may fail to distinguish them. The signs of incarceration or strangulation—pain in the belly, vomiting, and obstruction of the bowels—when present suffice for the diagnosis, but they may be imperfectly developed and thus equivocal. Then, in the absence of enlargement of contiguous glands, the part must be cut down upon and recourse had to direct inspection.

A lobulated painless swelling, devoid of impulse on coughing, and possessed of considerable solidity, is probably *a fatty tumour.* A femoral epiplocele is usually painful on manipulation.

A slight fulness in Scarpa's triangle, accompanied by pain referred to some part of the obturator nerve, and by the symptoms of obstruction of the bowels, points to *obturator hernia.* The absence of swelling does not negative the diagnosis, for, in the majority of recorded cases, the existence of a tumour was not ascertained during life. A careful comparison of both limbs should be made, and the pelvis examined per rectum or per vaginam, and, if necessary, the obturator foramen must be explored—by incision through the thigh, or by opening the abdominal cavity.

A resonant swelling, which expands and becomes more tense on coughing, situated above Poupart's ligament, but not occupying the inguinal canal, is a *ventral hernia.* The history of the bursting of a pelvic abscess, or of ligature of the external iliac artery, the presence of a cicatrix, and the condition of the femoral artery, afford corroborative evidence.

A soft swelling at the upper and inner part of the thigh—one which diminishes in size or disappears without gurgle or slip on elevation of the limb, and on the application of slight pressure—which returns of itself when the limb is pendent, even though compression be maintained over the crural ring and psoas tendon, is *varix of the saphenous vein.* The tributary branches are usually much dilated.

As regards the degree of impulse on coughing, it may be said that it is most forcible in hernia and least in varix. It varies in different cases of reducible abscess, according to the consistence of the pus and the width of the neck beneath Poupart's ligament. In some it is quite manifest, in others it is difficult to obtain.

The tumour is *solid, non-pulsating, and irreducible.* It probably consists of (1) enlarged lymphatic glands, (2) some form of new-growth, or (3) an undescended testicle.

If the swelling is multiple, and situated along Poupart's ligament, or in the course of the femoral vessels, it is *glandular* in nature. Then, if no lesion exists in the associated lymphatic vessels, the enlargement is almost certainly owing to some constitutional state — syphilis (excluding local infection), scrofula, or Hodgkin's disease.

The history of past infection, and the existence of other signs of syphilis, afford the required corroborative evidence on this head. The youth of the patient, and the past or simultaneous affection of other tissues, such as caries of bone, joint-disease, &c., point to *scrofulosis.*

If the tumour is of considerable size, and other groups of glands—axillary, cervical, &c.—are affected, it is a *lymphadenoma.* Excess of leucocytes in the blood and increase of the splenic dulness confirm the diagnosis. Suppuration and periadenoid induration are most marked in scrofula, least in lymphadenoma. Strain is not an infrequent cause of swelling of the inguinal glands.

If irritation of the peripheral lymphatics is discoverable, the glandular swelling is termed a *bubo.* This is said to be *sympathetic* when it is consecutive to acute inflammation, as from a chancre or a heel-gall, is accompanied by pain and tenderness, and shows a tendency to suppurate. Hard, painless, freely-movable glands constitute *indolent bubo*; and, from their prevailing size and shape, they are termed *amygdaloid.* The glands are welded into a confused mass from perilymphatic exudation. They are breaking down at several points, and the subject is of strumous habit. This is *scrofulous bubo.*

Cancerous disease—e.g. epithelioma of the penis or scrotum—is propagated, sooner or later, to the glands next in order; it also gives rise—notably when ulceration has commenced—to simple irritative enlargement. The differential diagnosis of the two conditions in the early stage is difficult. If removal of the primary growth is followed by marked subsidence of the sympathetic swelling it may be concluded that the latter is benign; if, on the other hand, the glands are very hard, massive, and a portion of it ulcerated, *the bubo is malignant.*

The *non-glandular solid tumours* of the groin include lipoma, osteoma, enchondroma, carcinoma of the skin, and malignant connective-tissue tumours, either purely sarcomatous or composite—e.g. myxo-sarcoma, osteo-sarcoma, &c. The special features of each are given fully elsewhere. If the tumour is freely movable, of doughy consistence, and lobulated, it is a *lipoma*; and the diagnosis is all the more certain if it is found that the growth has travelled from its original position. Or, the tumour is very hard, perhaps distinctly lobulated; it is fixed to the epiphysis of the femur or to the pelvis, either at the symphysis or sacro-iliac synchondrosis. It is an *enchondroma,* or, less probably, an *osteoma.*

Enlargement and rigidity of a muscle or tendon, especially near its attachment, is probably owing to ossification from strain. The adductor longus is peculiarly prone to this change. *See* RIDER'S BONE.

There is a swelling at the site of the inguinal canal; it gives the 'testicular sensation' on pressure, and the testicle is absent from the scrotum. It is a case of *undescended testicle.* Its solidity and want of translucency distinguish it from *encysted hydrocele.* The absence of impulse on coughing, and of resonance on percussion, prevent its being mistaken for *bubonocele.* Partial descent of the testicle predisposes to hernia; it is important, therefore, to bear in mind the possible association of the two.

A swelling in the groin which is marked by enlargement and accession of pain at the menstrual period, is very likely to be due to an *ovary* occupying the inguinal canal.

Several fluid tumours remain for consideration, viz.:—I. Cysts. (*a*) Enlarged bursa; (β) sebaceous tumour; (γ) encysted hydrocele of the cord; (δ) hygroma; (ϵ) hydatid cyst. II. Diffuse hydrocele of the cord. III. Effusion into the hip-joint. IV. Abscess.

If the tumour is situated over the hip-joint, and it is rendered more painful by abduction and extension of the limb, but not by percussion of the heel or great trochanter, it is probably caused by effusion into the *bursa* between the capsule of the hip-joint and the psoas tendon, and not by distension of the articular capsule.

A *sebaceous tumour* simulates chronic abscess and lipoma. To differentiate them, it must be ascertained if the swelling is lobulated, and the signs of local inflammation and the causes of glandular abscess must be looked for. In case of doubt a trocar and canula should be used.

A small tense and elastic swelling in the inguinal canal, which is possibly fluctuating and translucent, and is without resonance on percussion or impulse on coughing, is an *encysted hydrocele of the cord.* It has to be diagnosed from bubonocele, hernia, and undescended testis.

If the tumour dates from birth, and yields a clear lymph on puncture, it is a *congenital hygroma.* It may be purely cystic, or partly cystic and partly solid. It may be soft and puffy to the touch, or more or less tense and elastic, and its outline may be distinct and even, or indefinite and irregular.

If the tumour is marked by chronicity and painlessness, and the fluid drawn from it is clear, of low specific gravity, and free from albumin, it is an *hydatid cyst.* The finding of hooklets, echinococci, or secondary cysts in the fluid, settles the diagnosis.

Diffuse hydrocele of the cord may be reducible or irreducible. If reducible, the fluid flows steadily back under pressure; there is not the slip or gurgle as in reduction of a hernia. If irreducible, it is marked by fluctuation, absence of resonance, and possibly by translucency.

The chief varieties of *abscess* in the groin are—(1) Lymphatic and perilymphatic; (2) Psoas and iliac, including perityphlitic and perinephritic; (3) Articular and extra-capsular. Some of these are acute, others chronic. The majority of the first group are consecutive to irritation in the corresponding lymphatic areas.

If the tumour is reducible, and continuous fluctuation can be obtained above and below Poupart's ligament, whilst the spine shows angular curvature, it is an ordinary *psoas abscess.* There may be one on each side, and the two may communicate across the bodies of the vertebræ.

An *iliac abscess* may originate in the fossa of the same name, in the true pelvis, or about the kidney. These regions should be carefully explored. *A pericæcal abscess* is usually accompanied by the symptoms of obstruction of the bowels, and is commonly due to fæcal impaction.

It is difficult to diagnose with certainty suppuration within and immediately without the hip-joint. Pain on passive movement and percussion is generally greater in the former case.

Augustus J. Pepper.

GUINEA-WORM. *See* Filaria Medinensis.

GUM-BOIL.—This is an inflammation, usually running on to suppuration, about the apex of the root of a tooth, which comes to be enclosed in an abscess sac adherent to it at a little distance from its end. The pus from this abscess is very often evacuated through the pulp-canals, the pulp being almost invariably dead and decomposed in cases of gum-boil; but there is always some inflammation of the bone and periosteum overlying it, and if the exit *viâ* the pulp-chamber is not very free, the pus eats through the alveolar plate and appears on the surface of the gum, with more or less swelling; hence the name gum-boil.

The cause of the inflammation is, in the vast majority of instances, the escape from the pulp-chamber of the products of the decomposition of the pulp or of other matters which have found their way into the vacant pulp-chamber, thus making a poisoned wound at the apex of the root. The amount of pain and disturbance is pretty directly proportionate to the degree of confinement of the inflammatory products, so that the first thing to be done in the way of treatment is to open the tooth up freely and syringe it out, so as to enable the pus to well up through it, and to lance the gum deeply if it be much swollen. A gum-boil is in the best position for healing when there is an exit by way of the gum as well as through the root-canals; and if several drops of creosote, or other powerful antiseptic, can be pumped in through the tooth so as to find its way out through the opening on the gum, the abscess will usually heal immediately. When the inflammatory state has quite passed off, the tooth should be sealed, so as to prevent the access of foreign matters by way of the pulp-canals; but it is not enough merely to fill the cavity of decay, the root-canals must also be solidly filled or the abscess will soon recur, perhaps from the accumulation of serum in the canals and its subsequent decomposition.

If left to itself, relief is afforded by the escape of the matter, which from time to time re-forms, and a permanent fistulous opening remains in the gum; ultimately the end of the root becomes rough and more or less absorbed, so that the tooth gets loose. When the roots of a tooth are so long as to reach beyond the reflection of the mucous membrane on to the cheek, there is much more danger of the abscess bursting on the cheek or beneath the chin. If this threatens, every endeavour should be made to get a free opening through the tooth, and the skin should be supported by painting with collodion, &c.; it need hardly be said that under no circumstances should a poultice be applied externally, though a small bread poultice laid in between the cheek and the gum is soothing and useful. Slight degrees of inflammation, short of suppuration, may be treated by painting the gums with iodine, or with tincture of aconite; sometimes a mixture of these in equal parts is applied with benefit.

In cases of exceptional severity, necrosis of portions of the alveolar processes may ensue; or suppuration of the lymphatic glands; or pus may burrow down the neck; or enter the antrum, and set up suppuration there. Pyæmia and death have occasionally resulted from Alveolar Abscess.

Charles Tomes.

GUMMA.—It might be well perhaps that this term should pass out of surgical use, for it is exceedingly difficult to define it or to state to what conditions it should be restricted. Conventionally, it is used for any chronic swelling occurring in connection with syphilis. Formerly its use was limited by many to tumour-like indurations occurring in the cellular tissue and viscera in the tertiary stage; but it is now not infrequently applied to papules and tubercles developed in the skin at much earlier periods; and histologists can draw no line of distinction between the chronic sclerosis which attends the primary lesion of syphilis and those of its later stages.

A gumma, it may be said, always begins in cellular tissue, and is always slow in its development. In its later stages it is often attended by inflammation, which may cause the skin to give way over it, and may expose a mass of sloughy tissue which has aptly been compared to sodden wash-leather. In degree of hardness gummata vary very much, and the close similarity to new growth which they sometimes present is such as to make diagnosis very difficult. The certainty and rapidity with which they yield to the use of iodide of potassium are, however, such that the diagnosis and cure are not infrequently simultaneously effected.

It is when they are met with in the substance of the tongue or in that of a voluntary muscle that gummata are most likely to be mistaken for new growths. In these situations they are not infrequently exceedingly slow in their processes of change, and very firm in structure. The tendency to break down or suppurate varies very much in different parts. When suppuration occurs, it is to be understood that it takes place around, rather than actually in, the tissue involved. The latter may, however, break down and disintegrate, or may be detached by exfoliation. Indeed, when an abscess occurs in connection with a gumma, it is almost always accompanied by a slough or sequestrum. When a gumma has ulcerated the diagnosis from new-growth of a malignant character may sometimes still remain very difficult, and especially is this the case in gummatous ulcers of the tongue. The undermined edges, the sloughy base, and the entire absence of anything like warty outgrowth, will, however, generally suffice as grounds for a decision. If they do not, a short course of full doses of the iodide of potassium may be tried. As a rule, when a gumma undergoes resolution by treatment it disappears entirely, leaving little or no thickening of the part; but occasionally, and especially in connection with the periosteum, some permanent sclerosis results. Even in connection with bones, however, the completeness of the final resolution of very chronic and very firm lumps is often most remarkable.

Although iodide of potassium, as a rule, displays its power most definitely and rapidly in reference to all stages of the gummatous process, there are some cases which yield to mercury even more quickly than to it, and a few in which the latter will succeed when it has failed. Especially is the latter the case in certain indurations of periosteum of bone, which will yield to nothing but the full mercurial influence. In the treatment of ulcers from gummata which have broken down, local remedies are of great importance, and in many instances will alone suffice for cure. Amongst these iodoform is the chief. But not infrequently a free cauterisation with the acid nitrate of mercury will even yet more rapidly produce healthy action. The process of repair under appropriate treatment is usually rapid and complete. The scar left is often more or less peculiar, owing to the large amount of cellular tissue which may have been destroyed. In like manner, when a gumma in one of the viscera undergoes absorption, an internal cicatrix with surface depression is the common result.

Gummata have been recognised in almost all the viscera. They are common in connection with the testis, the liver, and the cerebral meninges. When occurring in the substance of the lung they lead to what is known as syphilitic phthisis, and both here, and in connection with the muscular substance of the heart, they are occasional causes of deaths directly from syphilis. In most of the positions just named, however, their recognition and treatment concern medical rather than surgical practice.

Amongst the peculiar forms of gumma may be mentioned those which develop in connection with the venous and lymphatic systems. In the late stages of tertiary syphilis we not infrequently witness a tendency to induration round the cellular tissue of the veins of the lower extremity, especially if these have been previously in a diseased condition. Lumps of induration, elongated in form, may be met with at more than one place on the same leg, and they may extend and become confluent, producing a large cake-like mass. Some of the most troublesome ulcers we encounter in the leg are the result of periphlebitic gummata. When the lymphatic system is affected we sometimes meet with little shot-like swellings, developed at variable positions in the course of lymphatic trunks. These are often very slow in their development, and remain for long without breaking down. They may occur at almost any stage of syphilis, but are less common in the later ones, and they appear, so far as the writer's experience has gone, to be more influenced by mercury than iodide of potassium.

Histologically, a gumma consists of what is known as granulation tissue, its softness or induration varying with the proportion of its cells. When its fluid constituents are abundant it presents on section a soft gelatinous appearance, from which its name is derived. Jonathan Hutchinson.

GUMS, Affections of the.—Hypertrophy of the Gums occurs as a congenital affection, and many cases of it have been recorded. In the *Medico-Chirurgical Transactions*, vol. lvi., is a record of three children of one family, who all presented hypertrophy of the gums, and were also the subjects of *molluscum fibrosum.* All three children were of weak intellect. The writer brought before the Odontological Society of Great Britain, in 1878, two remarkable cases of hypertrophy of the gums, one in a child of five years, and the other in a young man of twenty-six. In the child, the hypertrophy was general, involving the whole of the gums of both jaws; but, in the young man, it was partial, being confined to the gum and alveolus of the right side of the lower jaw, from the right wisdom tooth to the left canine.

A cure was effected in both cases by removing the affected alveolus with the contained teeth, by means of powerful cutting forceps, and nothing less severe is effectual, since it has been shown by Mr. Charles Tomes that, in these cases, the disease dips into the socket of the teeth, and that, therefore, mere paring away of the redundant gum does not effect a cure.

A *nævoid* condition of the gum is occasionally met with as a congenital affection, and co-existent with extensive port-wine staining of the face. In an otherwise healthy young woman, the nævoid growth appeared to take on greater activity with each pregnancy, and the writer removed the vascular outgrowth on two or three occasions, applying the actual cautery freely for the arrest of hæmorrhage.

A vascular, non-congenital tumour of the gum may originate from irritation of the teeth, especially in the region of the incisors. When small, these growths may be treated with caustics, but, if large, and causing hæmorrhage, they should be removed, and the surface from which they grew be touched with the actual cautery.

Polypus of the Gum, or simple hypertrophy due to irritation, is not uncommon in the neighbourhood of decayed teeth, or when an accumulation of tartar has been allowed to take place.

The affection, when of considerable size, may resemble epulis, but differs from it in being unconnected with the periosteum, and hence requires much milder treatment. The removal of the tartar or the decayed teeth and the use of an astringent wash are sufficient treatment in most cases, and if the growth is large it is generally pedunculated, and therefore readily snipped off with scissors, or, if sessile, may be cut off and cauterised with Paquelin's cautery.

Gingivitis, or inflammation of the gums, is a common affection in infants who are cutting their teeth. The mouth is hot and tender, there being a constant dribbling of saliva, and the child's health is interfered with by the loss of rest and by diarrhœa, and possible convulsions caused by the irritation of the system.

Free lancing of the gums is the only trustworthy remedy, and should be had immediate recourse to in all cases of severity, although in slight cases rubbing the gums with the *syrupus croci*, or one of the numerous but dangerously narcotic 'soothing syrups,' may be sufficient.

A *spongy condition* of the gums, often called scurvy, but which differs entirely from the gum of true scurvy, is common in persons who neglect the cleanliness of their teeth, or are in feeble health. According to Salter, the disease consists essentially in vascular dilatation of the papillary and other capillaries, with a general thickening of the gum itself. The treatment consists in improving the general health, and in using the tooth-brush vigorously with some astringent mouth-wash.

The spongy gum due to the administration of mercury differs from the preceding in presenting a well-defined red line along the margin of the gum before the sponginess comes on, combined with fetor of breath and a metallic taste. The blue line of plumbism is due to a formation of sulphide of lead, and the green line of copper-poisoning to the oxidation of copper in the superficial tissues of the gum.

In *true scurvy*, due to deprivation of vegetable diet, the gums are swollen and livid from submucous extravasations of blood, and they bleed on the slightest touch. In advanced cases the gums become black and sloughy, protruding between the lips, and are horribly offensive. Such cases are seldom seen except in seamen who have been improperly fed, and deprived of lime-juice during a long voyage; but mild cases of scurvy, characterised by subcutaneous ecchymoses in other parts of the body, may be met with, and, like the more severe ones, yield promptly to the administration of fresh fruit and vegetables.

Bleeding from gums apparently healthy is a common symptom of the hæmorrhagic diathesis, and may be best checked by pressure, and by the administration of hæmostatics in the form of iron and the mineral acids.

Epulis is a term often used to include any form of tumour involving the gum, but may be conveniently restricted to the fibrous form, which alone is strictly connected with the alveolus and gum. It is a slowly-growing tumour, arising most commonly between two teeth which may or may not be decayed. By pressure it tends to separate the teeth if they are healthy, or may completely cover in the stumps of decayed teeth. An epulis is closely connected with the periosteum of the alveolus. Mere cutting away of the growth is insufficient for its eradication, and nothing less than cutting away the portion of alveolus from which it springs, or inducing its exfoliation by the application of the actual cautery, can be relied on. In order to do this, it is generally necessary to sacrifice the tooth on each side of the growth, and occasionally in removing the tooth the whole growth comes away, being attached to the peri-odontal membrane in these cases, instead of to the alveolar periosteum. An epulis on section is found to consist of dense fibrous tissue, closely resembling the normal gum, and frequently contains masses of bone, which may or may not be directly continuous with the alveolus.

Myeloid Tumours are not uncommon about the alveoli (hence 'myeloid epulis'), but are only the superficial portions of deeper growths. The remarkable feature about these growths is the dark colour which is often to be seen on the surface of the gum-tumour, previous to or, more frequently, after removal. A very thorough and complete removal of these growths is necessary to ensure a cure, and hence they are more properly classed among tumours of the jaw, which they commonly involve.

Papilloma occasionally affects the gums, and requires free removal. Salter describes a case of the kind which occurred in Sir W. Fergusson's practice, where recurrence after removal had frequently taken place.

Ulceration of the Gum occurs in children as the result of stomatitis, but in the adult may be due to struma, syphilis, or epithelioma. Salter narrates a case of strumous ulceration affecting the gums and palate in a youth of nineteen, of highly strumous diathesis, and thinks the disease may be more common than is supposed. Syphilitic ulceration may affect the gums, as well as other portions of the buccal mucous membrane, and occurs, as a rule, below middle age.

Epithelioma affects the gum in patients over forty, and is often apparently connected with irritation caused by ill-fitting tooth-plates. Any ulceration in the mouth of an elderly patient, which does not heal readily, should arouse a suspicion of epithelioma, and this is to be insisted upon the more strongly, because in the early stage, cases of this description are generally seen by dentists, who do not always appreciate the full gravity of the case, and the necessity for prompt interference.

When fully developed, the ulceration is ragged and irregular, and tends to spread from the gum to the cheek externally, or to the side of the tongue internally. The teeth in the neighbourhood are loosened, and possibly the submaxillary lymphatic glands may be enlarged, as they always are in the later stages of the disease.

Having treated several cases of epithelioma of the gum, the writer is convinced that nothing but very free removal offers the patient a chance of permanent relief. It is impossible to say how deeply in the jaw the epitheliomatous growth may have penetrated, and, therefore, it is better not to be content with simply cutting away the alveolus with bone-forceps, but to remove a piece of the whole thickness of the jaw well beyond the disease. It is true that this leads to a permanent deformity, which one would gladly avoid; but to do less is almost to court failure, with possible infiltration of the lymphatics and a rapid termination. Christopher Heath.

GUNSHOT WOUNDS.—All injuries caused by projectiles impelled by the explosion of gunpowder have been included under the term 'gunshot.' They differ from the accidents of civil life in the peculiarities of the conditions attending them, the producing causes, the dangers and complications liable to arise in their course, and the difficulties which surround their treatment, often under very unfavourable conditions. Gunshot wounds may be most trivial in degree, or productive of injuries of terrible severity; yet in all their phases, whether simple or complicated, the principles which mark the advance of modern surgical science are as applicable to gunshot wounds as to the injuries met with in civil practice.

It is not easy to define precisely a gunshot wound, because under this title is included so great a variety of injuries produced by different kinds of firearms. We have bullet wounds occasioned by conical and round bullets, pistol shot, and small shot, as well as the extensive injuries which result from shell explosions. The latter, when produced by minute fragments, possess some of the characters of bullet wounds. In some cases they may be very severe, and resemble somewhat the extensive injuries caused by machinery, and met with in civil practice. In other instances a limb may be carried away, smashed up, or large portions of the body shattered out of all recognition by a shell exploding near at hand.

Bullet-wounds.—A wound by a rifle bullet may be defined in very general terms as a contused and lacerated wound, accompanied by loss of substance, and, in respect of its great length or depth compared with the size of the external orifice, it possesses peculiarities usually associated with punctured wounds. The gravity and relative importance of gunshot injuries are in relation to the region of the body struck, the structures implicated, the size, shape, density, and velocity of the projectile.

A bullet striking tangentially may inflict a mere contusion which, in the case of large projectiles, may be of the severest kind. It may groove the skin and subcutaneous tissue for a greater or less distance, or pass immediately beneath, causing the so-called seton wound. In other cases it may traverse the whole thickness of a limb, or the body itself, from side to side. It may go longitudinally, or in any other direction. In one case the soft parts only shall be injured; in others, the bone may be extensively comminuted and fissured. Vessels and nerves may be divided, viscera and great cavities wounded, and joints penetrated. In any of these cases, the ball or portions of clothing may remain embedded, entailing the evil consequences due to the presence of a foreign body. Again, the bullet shall emerge, often strangely altered in shape, or even divided into one or more portions. The track of the missile may be quite short, or extend along one-half or more of the body, bearing evidence of contusion throughout, and often perhaps of explosive violence.

In discussing the character and consequences of bullet injuries, reference will have to be chiefly made to those produced by conical projectiles. The old round ball is no longer in use. It was larger and softer than the modern bullet; but the chief differences in the wound it inflicted were due to its much lower velocity, the readiness with which it was deflected from the straight course, its very eccentric conduct in traversing the tissues, important parts lying apparently directly in the way being passed by uninjured or at most contused, and the frequency with which the bullet lodged. The conical rifle ball has an enormous initial velocity and great penetrating power. Its course through the body is more direct. It is less liable to deflection, and the damage it occasions is greater.

The modern bullet exhibits several varieties in shape and size. Usually it is a cylinder of lead with a rounded extremity, or in some cases ovoid in form, like the projectile of the needle-gun. One result of the rapid flight of the projectile is that in half of the cases in which it hits the body it is altered in shape. And when it strikes a bone, it is flattened and twisted in all manner of ways, or even divided into two or more portions.

When a bone is struck by a bullet at full speed, perpendicularly to the surface, it is apt to punch a round opening in it with sharp, well-defined margins. A loss of substance, equal to the area of the ball, will be seen at the point of entrance; the exit opening will be larger, more irregular, and the bone-margins more or less everted. Fissures almost universally co-exist. This form of fracture is best seen in the spongy extremities of the long bones and in the flat bones. It is rare in the compact tissue of the shaft. When the velocity is diminished, the bone may be the subject of partial fracture, an indent, a fissure, or a mere contusion.

In the soft parts the entrance wound is sharply defined, and smaller in area than the bullet, while its edges are contused, inverted, and depressed. The exit wound is irregular, with everted margins resembling an ordinary lacerated wound. A diminished velocity, as a rule, causes the wounds to be less regular and larger. The subsequent course of the bullet deviates greatly from the direct path. It is, perhaps, capable of penetrating but a short distance; it may even fall out of the wound again, or finally it may inflict only a contusion without breach of surface.

Grooving, furrowing, or gutter wounds are produced when the bullet strikes obliquely, so that it travels for some distance parallel to the surface. They are most frequently seen on the head, face, and extremities. They vary in length and depth from a mere scratch to a deep channel, with irregular, contused, and lacerated margins. Sharp angular fragments of shell often produce them, and they are very painful and tedious in healing.

Seton wounds are similar in type to the last in being superficial, but the projectile travels for a certain distance close beneath the surface of the body before it emerges. They may be an inch or two or several inches in length; the manner of production is by a bullet striking tangentially at full speed. They may be seen on all parts of the body except the head. The track of the ball is easily traced by the bluish discolouration on the surface. As the bullet does not meet with any hard body it is rarely much altered in shape, and the distinctive features of the entrance and exit wounds are usually well marked.

Traversing wounds constitute nearly half of all the injuries inflicted by gunshot. Sixty-five per cent. occur in the extremities, twelve per cent. in the head, seven per cent. in the chest, six per cent. in the abdomen, five per cent. in the back, and three per cent. in the neck. The greater number of gunshot wounds traverse the tissues, inflicting a variable degree of injury according to the nature of the resistance which the traversing projectile meets. Bone offers the greatest obstacle and generally suffers the most extensive injury. Skin, tendons, and fascia come next; they also are capable of altering the shape of the ball. Small leaden projectiles flatten on tendons as they generally do on bone. In the muscles there may be much loss of substance, especially if they be in a state of tension when struck. The viscera offer least resistance.

It is rare, except after a ricochet shot, to have more than one wound of entrance produced by a single bullet, but it not infrequently happens that there is more than one exit wound; more than two, however, are rarely seen. The high velocity of the ball often causes it, as has already been stated, to split into two or more portions when striking a bone, and the over-heating or partial melting of the bullet from the same cause renders this still more likely to ensue. A gunshot track is by no means a perfect cylinder, the opening in the skin is slightly smaller in area than that of the bullet, but in the aponeurosis there is often a mere slit, so that when suppuration occurs, it will be confined beneath the fascia. This circumstance no doubt led to the formerly much-employed practice of *debridement* or free incision of gunshot wounds. Balls make the largest channel through muscles.

The direction of the wound when a rifle ball strikes at full speed at right angles to the surface may be straight, but often it is very devious. A contracting muscle, a tense fascia, a tendon, and of course, bone, generally deflect a bullet. Any change of posture after the receipt of injury alters the direction of the track, which might become straight again could the individual replace the body in the exact attitude assumed at the moment of injury. The length varies;

it may be quite short; on the other hand, it may extend half the length of the body, or more. The soldier generally shoots in the recumbent posture, and when struck as he lies upon his face, the bullet may travel the entire length of the back, or from the wrist up to the shoulder, or entering the neck pass through the chest and abdomen, from before backwards or diagonally.

Gunshot injury may be complicated by wounds of the blood-vessels, nerves, viscera, or by the penetration of a great cavity or joint. These wounds are always severe and their prognosis serious; they occur much more frequently since the introduction of arms of precision.

The relative frequency with which wounds are met in the different regions of the body varies with the circumstances of every war. It is calculated that of 100 wounds, by gunshot, 13 will be found in the head, 19 in the trunk, 28 in the upper extremity, and 38 in the lower. There has been an increase during later campaigns in the number of head wounds, which may be accounted for by the method of modern fighting. During sieges and in fighting from trenches, the proportion of head injury varies from 25 to 30 per cent. Here the frequency of injury in the upper extremity remains the same, but the number of wounds in the trunk and lower extremities diminishes in proportion.

Wounds inflicted by pistol balls, either of the conical form, or, less frequently, the round shape, are often met with in civil practice. Generally the injury is self-inflicted; sometimes it is accidental. In the former case the weapon is always fired at very short range or point blank. The surface is often discoloured or burnt. Particles of unconsumed powder are embedded in the skin or neighbourhood of the wound. These injuries resemble, on a smaller scale, the wounds by rifle bullet. The size of the ball is smaller, it is impelled with less force, and the damage it inflicts in general is not so severe.

Injury by Small Shot.—Wounds produced by the discharge of small shot from fowling-pieces is one of the most frequent forms of gunshot injury met with in civil practice. The amount of damage they inflict varies according to the distance from which the piece is discharged. A charge of shot, delivered point blank, inflicts most extensive injury, entering the body like a solid mass of metal, and then spreading in all directions. Here the entrance wound will be very large, its margins crenated. In a few instances the charge, or the bulk of it, may traverse the part wounded. The exit wound in that case will be very irregular and lacerated, and has a sieve-like appearance at the margins from isolated shot-pellets passing out separately.

Injury by Explosive Shells.—The explosive conical shell, used in modern artillery warfare, produces injuries of very varying degree. The injury is caused by the impact of the fragments into which the iron case of the shell bursts, and the leaden sheath which surrounds it. The damage depends on the number and the size of the fragments striking the individual, and the proximity of the explosion. The pieces vary in weight from half an ounce to half a pound or more, and are of all possible varieties of shape. They inflict lacerated wounds, often very irregular; tear away large portions of tissue or even an entire limb, smash the bone, or possibly reduce the entire body into a shapeless mass.

The proportion of men wounded by artillery fire, to those injured by rifle bullets, varies much in different battles. In the war in Bohemia, 90 per cent. of the wounds were caused by rifle bullets, only 3 per cent. by fragments of shell. At Plevna the wounds inflicted were all bullet wounds. In the Franco-German war, 20 per cent. of the wounded on the French side were injured by artillery, and 70 per cent. by rifle shot, while among the Germans only 5 per cent. were injured by artillery, but 94 per cent. received rifle wounds, so that the proportion varies much. In sieges the number of shell injuries always proves excessive.

Symptoms of Gunshot Injury.—There is very often a singular absence of severe pain at the moment of the infliction of a wound. This is true even when important nerves are severed. The greater the excitement, the less is the pain experienced. In a considerable number of instances, a man will be unaware that he is even hit until he becomes faint from loss of blood. The majority experience a sensation as if struck a severe blow by a stick, others a species of electric shock. In a few a severe burning pain is felt, rarely bad enough to occasion syncope. The pain is occasionally referred to parts other than the one struck, as in the testicle from a wound in the upper part of the thigh, or in the heel from injury to the buttock. Afterwards the amount of suffering will depend much on the circumstances in which the wounded man is placed. The beaten soldier will feel it more than the victor, or than one speedily and well cared for.

It is notorious how different various nations are in respect of endurance of pain. Pirogoff observed that Jews, Mussulmans, and Slavs bore pain well. Italians and Poles are very sensitive. The writer observed a total indifference to suffering among the Turks. He has often witnessed soldiers dying of mortal injury quite cheerful and unrepining, and he remembers well a man whose arm had just been amputated, insisting on seeing the next operation performed, to know how it could be done while the patient was unconscious of pain, and calmly smoking a cigarette the while.

As a rule, primary bleeding is an unimportant symptom in cases of gunshot injury which come under treatment, wounds of the face perhaps excepted. But hæmorrhage is nevertheless the cause of death in the majority of those who die on the field itself. Those wounded in the abdomen usually present a blanched appearance, and the same thing holds good of wounds of the thorax. There is often much blood on the clothing and ground, primary hæmorrhage from large venous trunks being as rapidly fatal as from important arteries. It has been recommended that every soldier should be provided with a tourniquet, but, as no instance has been recorded of life being saved in this way, the instrument would be quite useless.

Ligature of a large vessel for primary hæmorrhage is an almost unknown operation. Lidell records, as his personal observation after several severe battles, that he had not met with a single case of primary hæmorrhage which required a surgical operation such as the application of a ligature, and a similar statement has been made by other experienced military surgeons. It has often, of course, been performed for secondary bleeding. The results, which it is not needful now to particularise, have not been unsatisfactory.

Shock is a prominent feature of many gunshot injuries. It does not always stand in direct relation with the severity of the wound; it may be severe even after slight injuries. Local shock—the 'wound stupor' of Pirogoff—is confined to the injured part, which after a period of severe pain becomes cold, blue, numb, and difficult to move. The condition may pass off, or motor and sensory paresis, with general shock, may be developed.

General shock is observed in the more severe forms of gunshot injury, as, for instance, where a limb has been extensively damaged, or the viscera wounded; symptoms of severe shock often following injury by shell-explosions. The larger the area of the superficial injury and the nearer it is to the centre of the body, the more intense will be the shock. In some less severe cases of injury it can only be accounted for by psychical causes. It is always greater in nervous persons, and in injury of certain regions, as the abdomen, genital organs, the fingers and toes. The normal bearing of a wounded soldier, however, is usually one of much fortitude and endurance of suffering. In general shock the patient becomes pale and faint; he trembles, the skin is cold and sweating, the pulse small and irregular, the respiration shallow and frequent. In other cases there is extreme restlessness, anxiety, and a feeling of impending death. After an interval reaction sets in, the face becomes flushed and restlessness increases, accompanied perhaps by delirium, exaltation of the senses, small and frequent pulse and rapid breathing. The temperature generally falls two or three degrees below the normal standard. Cases where there has been great loss of blood generally suffer severely from shock; on the other hand it is sometimes entirely absent, even after very severe injury. The usual treatment should be employed, warmth applied, stimulants administered, all bleeding stopped, and the patient made to feel that he is being cared for.

Instantaneous rigor mortis is a condition occasionally observed after sudden death from gunshot wound. Instances of this almost inexplicable phenomenon are observed on all large battlefields. The bodies of the dead are to be seen with the action in which they were engaged during the last moments of life apparently continued; the position is probably one quite contrary to the action of gravity. The last muscular effort is stereotyped as it were. This condition may remain persistent for days, as the writer has personally witnessed. The expression of countenance at the moment of death is also preserved, and the body has the appearance of continuing the effort to accomplish some object desired at the moment of death. Dr. Dossbach mentions the case of six Frenchmen killed by a shell as they were taking breakfast; one appeared to be laughing, the man next to him was holding a tin cup to his lips between his thumb and forefinger. Dr. Brinton mentions the case of a cavalry soldier who was instantaneously killed while in the act of mounting his picketed horse; he was found with his foot in his stirrup, his left hand on the bridle and horse's mane, and when the body afterwards fell to the ground it remained quite rigid in the attitude described. This condition occurs most frequently after injuries to the brain and spinal cord. Dubois-Reymond has called it cataleptic rigor mortis. Any explanation seems very difficult.

PROGRESS OF GUNSHOT WOUNDS OF THE SOFT PARTS.—Formerly suppuration was the all but inevitable result of gunshot wounds. An effort is now made to procure healing by scabbing, and if the circumstances be favourable, these wounds heal oftener without suppuration than is commonly imagined. The smaller the bullet the more likely is union without suppuration to follow. The writer has seen pistol wounds heal by first intention, and not infrequently wounds produced by a rifle bullet, more especially that of exit.

It is the absence of suitable treatment in the first instance, the too frequent interference with the wound, the introduction of septic matter from without, and the insanitary conditions in which the wounded are placed, which render healing without suppuration comparatively rare. Langenbeck in the war of 1850, Stromeyer and Beck in 1864, the English and French surgeons in the Crimea, had never seen cases of recovery without suppuration, and, without doubt, suppuration is the rule in such cases. Baudens and Jobert saw wounds unite without suppuration which had been inflicted during the street fighting in Paris. Pirogoff has noted cases of union occurring primarily after wounds by small copper bullets; and during the Franco-German and Russo-Turkish wars many instances are reported of this manner of healing. A scab is formed by the blood and serum drying up. Absorption of the poured-out fluids in the interior of the wound occurs, and perfect recovery follows. In some cases of apparent primary union suppuration sets in at a later period, generally spreading from the entrance wound, whose bruised margins are prone to suppurate; or suppuration begins afresh in the interior of the wound a considerable time after cicatrisation. This is usually caused by the irritation of a foreign body, such as pieces of clothing and the bullet, which, even after an interval of years of quiescence, may excite inflammation and suppuration afresh. When suppuration takes place, it is often tardy in its appearance. For a week, or even ten days, there may be only a bloody serous discharge, attended by some inflammatory swelling in the immediate neighbourhood of the wound. The degree of fever is variable. There is often little or none, or severe traumatic fever may set in, merging, in too many cases, into the septic form. When the wound is treated antiseptically, both local and general symptoms are minimised.

The secondary stage extends from the occurrence of suppuration to the time when all particles of dead tissue are cast off and a granulating surface takes the place of a contused one. The fever abates, the swelling diminishes, and the ordinary changes of repair follow. The duration of this stage varies with the extent of the injury, the method of treatment, the constitution of the individual, and the circumstances in which he is placed. Cicatrisation may occur in the centre of the canal, or one or other external wound may close, the wound of exit being the first to heal. The period required for complete healing varies very much. From three to six weeks is a common estimate, but in complicated cases from three to six months may elapse before final cicatrisation takes place. Wounds caused by splinters of shell heal more readily than those inflicted by rifle bullets. The cicatrix may be adherent. It is often painful and neuralgic, as well as very sensitive to changes of weather. When the wound is deep and extended, the venous circulation may be interfered with, and chronic œdema ensue. The writer has seen this invade an entire limb; the extremities, however, are the parts usually most affected.

Diffuse suppuration is a common result of gunshot injury, and very commonly associated with a septic condition. Before the introduction of antiseptic methods this was a frequent source of death. The writer has again and again seen this, both in simple wounds involving the soft parts and those implicating the bone. The pus spreads in the cellular tissue between the muscles, and in the neighbourhood of the bone. It is most common in deep-seated wounds. Septic phlegmon is a very common cause of death after gunshot fracture. It may also occur in wounds of the soft parts. The suppuration in this case becomes widely diffused beneath the fascia. There is often a hard œdema. The skin is red and shining, the wound grey and foul, with a profuse secretion of ill-smelling pus, high fever, albuminous urine, diarrhœa, delirium, and finally a typhoid state. Upon incision the tissues are found dense, with greyish infiltration. Death generally occurs through sepsis or exhaustion. There is no tendency to limitation. United fractures or partially cicatrised wounds break down again.

Septic suppuration, followed by infection, is common in all wars. Its frequency has been much diminished by the introduction of antiseptic methods. Formerly it more than decimated the wounded, and was especially common and fatal after gunshot fractures and operations which involved the bones.

Complications in the Course of Gunshot Wounds.—Secondary hæmorrhage is one of the most common and fatal of the accidental complications following gunshot injuries. The period of separation of the slough in the gunshot track is frequently associated with secondary hæmorrhage. Severe and fatal bleeding, however, may occur at any later period, and, as the writer has observed, even after apparent convalescence has taken place, more especially in wounds of the neck and face. In this case, perhaps, only a small fistula or trifling discharge persists. After ligature of the vessels, and after amputation, secondary hæmorrhage is very frequent. The operation may perhaps have been hastily done. The patient is transported a long distance afterwards, the wound suppurates, the after-dressing is imperfect, the food is bad, and the hygienic conditions probably even worse. The separation of a slough, and imperfect organisation of the clot, are the exciting causes. These are the principal conditions which occasion the distressing frequency of secondary hæmorrhage in time of war. It occurs most commonly in the evening or night, when the patient is feverish and restless. It may follow a prolonged dressing, accompanied by much syringing out of the wound, or a too frequent examination of the wounded part.

Warning bleedings to a limited amount precede the outbreak of the more severe hæmorrhagic attacks in about one-fourth of the cases. In only a small proportion does secondary hæmorrhage occur on a single occasion. It usually recurs twice, thrice, or even several times. Usually it is not difficult to distinguish arterial from venous and capillary bleeding; but when the blood comes oozing from a long, deep track, it may not prove easy to determine its source.

Secondary bleeding occurs early on the fourth or fifth day; it ensues with, perhaps, equal frequency till the eighth or tenth, reaching its maximum on the tenth and eleventh days, when the greatest number of hæmorrhages occurs. It then remains nearly stationary till the fifteenth or sixteenth day, when it begins to diminish in frequency, up till, say, the thirtieth day. After amputation, bleeding most frequently ensues at the period when the ligatures separate. The mortality after secondary hæmorrhage has been variously estimated at from 60 to 80 per cent. of the cases. It differs in the different regions of the body, but is greater in cases of gunshot fracture than where the soft parts only are concerned.

The *treatment*, in the first instance, is guided by simple principles. If the bleeding is severe, or cannot be arrested by pressure and other means, an effort must be made to stop the bleeding at the injured point. The ends of the vessels must be laid bare by dissection, and a double ligature applied; only where the attempt to secure the bleeding points in the wound fails may a ligature be applied at a distance. The mortality after ligatures in continuity is one-third greater than that following ligation in the wound. The results of treatment, as the high rate of mortality shows, are not favourable. In the wound itself there are always difficulties to be overcome in reaching the seat of hæmorrhage—difficulties which may prove insuperable. In regard to tying the artery in its continuity, the effect on the hæmorrhage is often very trifling, or only temporary; and, even if it be arrested, the bleeding often recurs at the time the ligature separates. The fact that the occurrence of secondary hæmorrhage so often depends on faulty hygienic conditions, overcrowding, and a foul condition of the wound, serves to explain the non-success of local measures for its arrest.

Tetanus is a somewhat rare complication of gunshot wounds, although it is commonly supposed to be frequent. It occurs oftenest in those who have been exposed to hardship, extremes of heat and cold, presence of bone-splinters, unskilful treatment of the wound, and in cases of injury to nerves. The writer only saw one instance in upwards of one thousand wounded at Sedan, and in that one the man had been exposed for three days on the battle-field before he was picked up. During the Revolution of 1830 three hundred and ninety wounded persons were carried direct from the streets of Paris into the Hotel Dieu. Only one of these suffered afterwards from tetanus. In the American war the frequency was only 0·2 per cent., or two in one thousand. It occurs with preponderating frequency, or in more than half the cases, after injury of the lower extremities. Tetanus is especially rare after wounds of the chest; the later the period of its occurrence after the injury the more favourable is the prognosis. Recovery occasionally takes place in the slighter or more chronic forms. It is exceedingly rare in the well-developed acute form, when death is apt to take place within three days. Out of 203 acute cases observed during the American war only 2 recovered. The total number of all kinds of cases was 337, of which 316 terminated fatally. *See* TETANUS.

In a few instances the symptoms abate on the removal of the projectile or foreign body. Amputation was successful in one-third of the cases in which it was resorted to. The treatment otherwise is purely empirical. All forms of narcotics have been tried in succession, with equally little effect upon the progress of the malady.

GANGRENE.—Acute gangrene may take place as the result of the wound of an important blood-vessel. Division of the sciatic nerve seems sometimes to produce it, or the severe smash occasioned by a shell-explosion.

Dry gangrene is excessively rare.

In the vast majority of the cases—as many as 90 per cent.—gangrene of some kind is the result of injury to the extremities. In two-thirds of these cases the lower extremities, and in one-third the upper extremities, will be the part involved. The general mortality is about 50 per cent. Traumatic delirium soon occurs. There are great restlessness, want of sleep, and anxiety. Symptoms of septic infection frequently supervene. In a certain number of cases amputation may be resorted to.

HOSPITAL GANGRENE is an epidemic contagious disease occurring in over-filled, badly ventilated, foul hospitals. It is especially prone to attack gunshot wounds. The first great epidemics described occurred during the Peninsular campaign in 1810–13. The disease, however, seems to have been known to Paré. In the latter six months of 1813 Guthrie treated 1,614 cases, of which 512 were fatal. The disease at the same time overran all the French hospitals. Out of 1,900 wounded in the Hôpital St. Louis in Paris, 500 perished of hospital gangrene. It was very severe after the battle of Waterloo in the hospitals of Brussels and Antwerp. It was common at Scutari and Malta during the Crimean campaign, and very bad amongst the French troops, especially in their ill-equipped transport ships. At Lucknow, in 1857, nearly all the wounded were attacked. It was common in the American war in 1864, when 2,642 instances were recorded. Scarcely any cases were observed during the Franco-German war, except in some of the hospitals of the reserve and in the besieged fortresses of Metz and Strasburg. A good many, however, occurred in Orleans.

The presence of epidemic disease such as typhus, cholera, scarlet fever, and diphtheria, seems to promote the occurrence of hospital gangrene, which Pitha, indeed, terms 'wound cholera.' The virus is very contagious; it may be carried from one wound to another by sponges, instruments, even the surgeon's fingers or clothing. It may appear even on a recently blistered surface. Wounds of fascia, tendons, and soft parts generally seem more prone to it than gunshot fractures. *See* HOSPITAL GANGRENE.

ERYSIPELAS is an uncommon occurrence after gunshot injury. American records place it at 4·0 per 1,000; it occurs after exposure to cold, and from great changes in temperature. The washing out of the wards is often followed by an outbreak of erysipelas. It occurs more especially on the head, face, and neck, or in about six cases in every thousand. On the trunk the proportion is 1·2, in the upper extremities it is 5·2, and in the lower 4·7 out of every 1,000 cases of wound. It may take place at any stage of the wound. It is very contagious. The duration averages ten days. It is often associated with or followed by pyæmia.

Generally the disease broke out in ill-ventilated, crowded hospitals, or was communicated by contagion.

Bromine vapour has been found a useful prophylactic, and without doubt the general introduction of disinfectants and antiseptic treatment will practically banish it. Sporadic cases, however, may ensue, even under what appear the best arrangements. These must at once be isolated, and otherwise the same treatment which is adopted in civil practice should be carried out. Antiseptic treatment to a large extent prevents erysipelas. Alcoholic stimulants, quinine, salicylate of soda, benzoate of soda, and narcotics are the remedies indicated, together with local subcutaneous injections of a third per cent. carbolic solution immediately around the diseased area, which prove especially useful at the beginning of the disease. *See* ERYSIPELAS.

GENERAL TREATMENT OF GUNSHOT INJURIES.—The means for removing the wounded from a battlefield to the dressing-stations and field-hospitals is treated of under AMBULANCE. It is only necessary to say here that the simplest form of stretcher

—one that can afterwards be used as a bed—is the best. The recovery of many will depend on how this part of the work is carried out.

Cases of fracture bear transport badly, and the chances of recovery after gunshot fracture of the thigh depend, to a large extent, on the ability of the surgeon to treat the cases as near as possible to the place where the wound has been received.

At the first dressing-stations it is imperative that the best surgical opinion should be forthcoming, for on the early diagnosis of the nature of the injury will depend the success of the treatment. Here, too, must be decided what treatment—conservative measures with antiseptic occlusion of the wound, amputation, or resection—will be best. The surgeon should not waste time over hopeless cases. None but operations of emergency should be performed on the field. Bleeding must be arrested, fractured limbs supported, limbs completely smashed amputated, the wounded refreshed and comforted, and then despatched as quickly as is practicable to the field-hospitals. In them complete examinations can be made, thorough antiseptic precautions taken, and the needful operations performed. With regard to the much discussed question of first dressings, the writer is convinced that the first dressing should, if possible, be a final dressing, and that this should be the aim of all military surgeons. He has but a limited belief in the practical efficiency of the packet of first dressings as carried by the soldier himself.

The frequent necessity for the extraction of a lodged bullet, a fragment of shell, or portion of clothing is peculiar to gunshot injury. Popular belief ascribes a deadly influence to the presence of a bullet in the body, and the wounded man urgently begs for its removal, the surgeon too often making an extensive and damaging search for it. A great variety of ingenious bullet-extractors and bullet-searchers have been invented. We have plain probes, articulated probes, probes tipped with porcelain, electrical indicators, instruments gimlet and spoon-shaped. A strong slender bullet-forceps, like Luer's, or the American forceps with rat teeth at the extremity, is the best. It is narrow enough to enter an ordinary gunshot track; when closed it acts as a sound, and if it seize the ball, is not likely to slip. It is quite certain, however, that the former indiscriminate extraction of bullets was often attended with evil consequences, and that vastly more injury was inflicted by ill-judged efforts to remove the ball than its mere presence was likely to induce. If the ball, however, prove accessible, and its removal easy, it may be better to extract it; but long-continued search after a deeply placed ball, or extensive incisions for its release, are to be deprecated. The wound should be treated irrespectively of its presence. It may become encapsuled, or even be removed at a later period.

In cases where the bullet requires to be removed, as where it presses upon an important vessel or nerve, or excites irritation by its presence, the operation should be conducted with extreme caution and the avoidance of all needless suffering. The part should be placed, if possible, in the same position as at the time of the receipt of injury. The gunshot track is thus straightened and shortened. Care must be taken not to mistake a bony prominence for a bullet. Stromeyer mentions a case in which the head of the fibula was thus cut down upon. The writer has known more than one instance in which an attempt was made to extract the transverse process of a vertebra, fatal hæmorrhage resulting.

The treatment of shock after extensive injury first demands attention, especially when produced by shell-explosions. If very severe it may even terminate fatally. Brandy, wine, ammonia, injections of ether, heat to the surface, and sinapisms, as well as stimulating injections per rectum, may be resorted to. In cases of slight shock it is unnecessary to interfere, but excessive reaction must always be guarded against.

The dressing of a gunshot wound must necessarily be of a simple character. In those cases where it is possible, an antiseptic pad, composed of cotton wool impregnated with iodoform or corrosive sublimate, should be resorted to as soon as possible after the receipt of injury, and fastened with a bandage—not, however, too tightly applied. The method of antiseptic occlusion seems to promise the most favourable results, especially in cases of gunshot fractures and injuries involving joints. This is not practicable when the wound is very large, irregular, and with contused margins, or when a considerable interval has taken place after the receipt of injury. Provision should then be made for the freest possible escape of the discharges. Drainage-tubes may be inserted, counter-openings made, and antiseptic irrigation, with frequent change of the dressing, resorted to. The strictest cleanliness must always be enforced, and all used dressings be burnt at once.

The general treatment consists in absolute rest of body and mind. A generous diet should be exhibited, but of a plain and simple description. The bowels ought to be kept regular with gentle purgatives. Anodynes are well borne, and should be given in sufficiently large doses to allay pain and excitement. In young, plethoric subjects, leeching is sometimes indicated, but general blood-letting is never likely to be required. If blood-poisoning threaten, quinine and opium are the most trustworthy remedies. Severe diarrhœa is a very common complication of gunshot injury, and for this, iron and opium are the drugs chiefly indicated.

Special Forms of Gunshot Injury.—Gunshot injuries of *bone* may be classified as contusions, simple fractures, partial perforating, penetrating, and complete fractures. Every form of projectile used in war may cause these various injuries. The nature, extent, and severity of the lesion will depend on the size, form, and velocity of the missile. The discussion as to the comparative effects of the round and conoidal bullets is no longer of practical value since the general adoption of arms of precision. To the cylindriform bullet all now agree in ascribing a greater destructive power. The frequency of gunshot fractures varies much in different campaigns. On the average they occur in about one-fifth of the total number of gunshot wounds.

Gunshot fracture of bone presents special features according to the character of the portion injured, the size and velocity of the projectile. Extensive damage to the bone is associated with comparatively trifling injury to the soft parts—a feature common to all kinds of gunshot fracture, and the converse of what obtains in fractures met with in civil practice. A bullet striking at right angles at full speed makes a canal in the bone, of the same size as the ball itself; the wound of entrance being a clearly-defined, circular opening in the cortical tissue, from which fissures extend upwards and downwards, the exit wound being larger, more irregular, more extensively comminuted and fissured than that of entrance. When the ball strikes obliquely, the bone will be comminuted. If it strikes tangentially, a piece of bone may be carried away, thus producing partial fracture, which may or may not be afterwards rendered complete by the weight of the body or the application of some indirect force.

The simplest form of injury is that in which the bone is contused. In some cases the surface may be depressed, the injury taking place in conjunction with wounds of the soft parts. There will be extravasation of blood beneath the periosteum and in the medulla. The injury most frequently occurs in the exposed bones, especially the lower jaw, the tibia, and the skull. The diagnosis is difficult, as the slighter forms of injury are mostly overlooked at the time. They are generally only recognised by the after-consequences. Their presence may be inferred when the wound is close to a bone, when the ball is found to be altered in shape during its passage, or by a sudden invasion of bone-inflammation or osteitis.

The symptoms are obscure, but a peculiar boring, burning pain is experienced in the bone, the functions of the limb are interfered with, and a swelling may be felt beneath the periosteum. In slight cases, where the conditions are favourable, desirable results may follow, the extravasation is absorbed, and some local formation of new bone may take place. In unfavourable cases, suppurative periostitis commonly occurs, and necrosis. The sequestrum may separate in the usual way, or osteo-myelitis and septic poisoning may take place. The injured part must, in any case, be kept at rest, and symptoms dealt with as they arise.

The bullet may merely groove or furrow the bone, either superficially or deeply, or drive the cortical portion into the medulla. Portions of the bullet are often found embedded, or the ball may be altered in shape or lodge at the end of the furrow. Fissures will probably be always found. This kind of injury generally takes place at the junction of the epiphysis and the shaft. A ball passing between the radius and ulna, or the tibia and fibula, will very often groove both bones. In other cases the ball may pierce the cortical tissue and lodge in a blind canal in the bone. This occurs in the epiphysis and spongy bone. In some of these cases there will be fissures, in others none. The diagnosis is difficult, and the nature of the injury is often only discovered by the subsequent progress of the case. If the ball can be extracted, these fractures will resemble in their progress simple grooving wounds. If not removed, the bullet may become encapsuled or excite inflammatory processes at some subsequent period.

The bullet may pass through the entire thickness of the shaft or extremity of a bone, cutting a channel through it without causing complete solution of continuity. This form of fracture is called *Lochschuss*, or keyhole. It is usually met with in the spongy extremities of the long bones near their junction with the shaft, and is more frequently produced by small bullets. The entrance wound in the bone is the same size as the ball, circular in form, the edges sharp and depressed. The exit wound is large, irregular, the margins everted. Longitudinal fissures are almost always present. At fifteen yards' distance, a chassepôt bullet, fired through the lower epiphysis of the femur, makes a perfectly round wound of entrance, the exit orifice being about ten times as large. The ovoid needle-gun ball, at the same distance, also makes a round entrance-hole in the bone, the exit wound being two or three times larger. The Martini-Henry effects a round entrance, a larger but also rounded exit wound, with limited fissuring. An exact diagnosis, even with the aid of the finger, is sometimes difficult. When recovery ensues, small fragments of bone exfoliate, and the canal becomes filled up, either by callus or fibrous tissue.

The successful treatment of gunshot fracture depends in a great degree on the possibility of antiseptic occlusion, careful immobilisation, and the absence of prolonged transport. Although much longer delayed than in any other kinds of fracture, final consolidation is almost the constant result. The average period of union is one month for the forearm, two months for the arm, three months for the leg, and six for the thigh. A useful limb is generally obtained, but always more or less deformed and shortened. Non-union is exceedingly rare. Death may ensue soon after the injury from shock, hæmorrhage, or injury to some important organ.

After a battle hospitals are filled with cases of fracture. A great many of the subjects die from acute septic poisoning. In some the fatal result may be averted by timely amputation; but when a septic condition is developed, amputation is exceedingly fatal. At a later period amputation may become necessary from the extent of the necrosed fragments, a profuse suppuration exhausting the patient, suppuration taking place in an adjacent joint, or large bedsores forming by reason of defective nursing.

The practice, formerly much in vogue, of extracting and excising fragments of broken bone is now very properly abandoned. Primary resection of the extremities of the fracture should never be performed; it leads to delayed union, false-joint, or sets up osteomyelitis and necrosis. Pieces apparently loose will often unite quite well, and the attempt to remove them may seriously damage the soft parts. It will, however, in some instances be desirable to remove a fragment of bone pressing upon a nerve or artery, and lying quite loose in the wound or transverse to the axis of the bone.

After the wound has been dressed the fractured limb must be immobilised, the joint above and below the seat of fracture included, and this must be thoroughly done, especially in cases which involve transportation. For these nothing can be better than some modification of the so-called Bavarian splint. Plaster of Paris properly employed, the writer considers, is invaluable. In the treatment of fractures Stromeyer strongly objected to it, and pointed to evil consequences resulting from its use; but these, with reasonable care, may be avoided. His great contemporary, Langenbeck, is very strongly in favour of its employment.

Fracture-apparatus for use in war must be simple, light, strong, and portable. Splints have been supplied of all possible material —tin, zinc, iron, wood, rattan, and wire, but all military surgeons should learn to utilise every available material on the spot. For almost all injuries of the upper extremity Stromeyer's triangular cushion will be found to yield adequate support; in the first instance, at all events, in the lower limb. The straight position, combined with continuous extension, is the best for all kinds of fracture of the thigh. Nathan Smith's or Hodgen's anterior wire-splints, with suspension, are admirable. These splints help to prevent bed-sores—not the least of their many advantages.

In fractures of the leg plaster of Paris splints may be used, a window being left at the wound. Starch, dextrine, white of egg, and water glass are much less desirable media, and are supplanted completely by plaster of Paris. Unfortunately it requires a considerable time to apply plaster splints properly; the weak parts, where windows occur, may be strengthened by slips of thin wood or iron. Undue pressure must be avoided at first, and subsequently the limb must not be allowed to become loose in the splint. Gunshot fractures of the leg are the most frequent variety of fracture of the long bones, amounting to about 31 per cent. of the total number of cases. Those of the humerus come next in frequency, being 28 per cent.; gunshot fractures of the femur amount to 22 per cent., and of the bones of the forearm to 18 per cent.

The views of surgeons as to the methods of treatment and propriety of amputation have greatly differed. At the present time, however, they are decidedly in favour of conservative measures in the majority of cases, especially of fracture of the shaft of the bone. When the fracture is near the ankle or the knee, these joints will probably be involved, and amputation may be the safer proceeding. In choosing a line of treatment, much will depend on the facilities which circumstances afford for satisfactory after-treatment, and the absence of long transport. The limb should be immobilised in a fracture-box or plaster of Paris. Union takes place very slowly; detached portions of bone may be removed, but any more formal resection of the extremities of fractured bones is strongly to be deprecated. When conservative treatment, from any cause, fails, amputation may be practised subsequently. In these, as in other cases, the results will depend on how far antiseptic methods of treatment have proved successful.

GUNSHOT INJURY OF JOINTS. — The number of these wounds varies in different campaigns, but the difference may be accounted for to some extent by the accuracy of the diagnosis. It is estimated that they form from one to two per cent. of the total number of injuries, but they amounted to as much as six per cent. during the Franco-German war. Their frequency is about equal in the upper and lower extremities. The shoulder and knee are the articulations most frequently implicated, the elbow comes next in order, the hip and wrists being the least frequently wounded. The left shoulder is more frequently injured than the right, and the right elbow than the left, which may be explained by the position which a man assumes in firing.

A joint is frequently injured, as before stated, by fissures issuing from an adjacent fracture. In fractures of the upper end of the tibia, fissures almost invariably extend into the knee-joint. Formerly contour-wounds, passing around the joint without opening into it, were described as of frequent occurrence. They certainly are not so now. Wounds apparently of this nature generally implicate the articulation. Injury to the joint-capsule alone is of somewhat common occurrence; this may take place in the knee without injury to the bone, but a gunshot wound implicating the capsule of the hip-joint invariably damages the acetabulum or the head and neck of the femur.

One or both of the joint-surfaces may be grooved or extensively comminuted and fissured by the bullet; the bullet or a portion of clothing may even find admission; the importance of the injury depends upon the extent to which the bone is damaged. It is often extremely difficult to decide if a joint has been opened or not, and to what extent the bones are injured; this will be especially so where the articulation is covered with a great thickness of soft parts. A diagnosis may be arrived at from the position and direction of the wound, and presence or absence of crepitus; an escape of synovia is seldom observed. Sudden swelling immediately following the injury is a very definite symptom, but it is often absent, or, as in the case of the hip-joint, difficult to determine distinctly. Pain is not a prominent symptom. When the bullet has traversed a joint, the patient cannot use it; sometimes, however, he may be able to walk a certain distance, and this has been repeatedly observed even when the head of the femur has been comminuted and the bullet lodged in the bone. In the case of the hip-joint the direction of the wound offers the best indication.

Formerly a gunshot wound implicating a large joint was regarded as certain to occasion suppuration and necessitate amputation. During the Crimean War and in the Italian campaign, the French surgeons amputated the limb for wound of the elbow, and amputation was almost universally considered necessary for penetrating wounds. It is now certain, however, that many gunshot fractures, even of the lower joints, may be recovered from with little or no inflammatory reaction. In many cases a changed position of the limb will alter the wound from a direct to a valvular one, and thus shut off the interior of the joint from external influences, especially in the case of the knee; the great thickness of soft parts covering the hip and shoulder may procure the same result for these joints. But in the wrist and elbow recovery has also been observed without suppuration.

Langenbeck informed the writer that during the war of 1870 and 1871, he had seen a hundred cases of penetrating wound of the knee-joint, in which recovery had ensued without suppuration. Socin has recorded fifteen cases of gunshot fracture involving the knee-joint which he had observed during the same war. In eleven of these recovery took place without suppuration in the joint. In some there was no reaction; in others, a limited amount of swelling and pain took place in the joint, or a trifling suppuration in the external wound.

The brilliant results obtained by Bergmann and Reyher in the Russo-Turkish war, lead us to hope much from the application of antiseptic treatment in gunshot injury of joints. It is necessary to bear in mind, however, that joint-inflammation often sets in very late, especially in wounds of the hip, and doubtless it is sometimes excited by untimely transport in wounds which might otherwise have remained quiescent. Suppuration is, unfortunately, the common consequence of gunshot injury involving an articulation, either from fracture of the joint or a fissure extending into it.

All gunshot injuries of joints are severe, and their danger is in proportion to the extent of the synovial surface. Pyæmia is the almost constant cause of death, amounting to as much as 90 per cent. The mortality after the Franco-German and American wars amounted, for the wrist to about 12, the elbow 20, the ankle 24, the shoulder 33, the knee 50, and the hip 80 per cent.

In all cases where antiseptic occlusion can be resorted to, this method of treatment should be adopted, together with perfect immobilisation of the part. Where inflammatory reaction has already taken place, the joint may still be immobilised, free incisions made into the articulation, all foreign bodies and loose fragments of bone removed, the interior thoroughly disinfected, and efficient drainage provided for. When the damage is too extensive to admit of conservative treatment, excision may be performed or amputation prove necessary. Formerly the universal practice was to amputate in all cases of injury to joints.

External circumstances may sometimes render amputation the better course: want of nursing, long transport, a badly equipped and ventilated field hospital. Of course antiseptic treatment when applied helps to neutralise these. If septic changes have taken place in the wound, amputation is best; secondary incisions and drainage under these circumstances used to prove very fatal. This difficult question must be decided at the first dressing-place—whether a comparatively easy amputation or the more difficult conservative treatment should be adopted. Secondary amputation generally comes too late, and in respect of mortality, as compared with primary amputation, one may say with Hueter: 'It is as the difference in pulling a sinking man out of the water after one or after ten minutes' immersion.'

When the occlusive treatment has been begun at the first dressing-place, it should be continued in the field-hospital, unless some pressing contraindication occurs. To realise healing under a scab, the dressing should remain as long as possible without change. When this becomes necessary, fresh pads should be applied. If fever, however, arise with the evening increase of temperature, œdema of the limb, pain in the joint, or rigor, the part must be carefully examined. If the suppuration be not extensive, the joint may be washed out and the wound utilised for drainage purposes, or, if unfavourably placed, a counter-opening may be made. If phlegmonous inflammation be great, the joint must be washed out antiseptically, the plaster splint removed and a posterior splint substituted. If the septic processes be not thus arrested, excision or amputation will become necessary.

In cases where antiseptic drainage has already been adopted, the dressing must be practised only when absolutely necessary, and washing out should be sparingly resorted to. If sepsis sets in, the rules previously laid down are to be followed. In cases of profuse and long-continued suppuration, the joint should be examined for foreign bodies and loose fragments of bone. If the patient arrives at the field-hospital with the joint already in a septic condition, an attempt should be made to purify it, although this may often fail. When the joint-cavity becomes shut off, and the external wound remains open, simple dressings only will be required. Fistulæ may be cleaned with a sharp spoon. Inflammation in the perisynovial tissue, or serous effusion into the joint, may be treated by iodine applications and methodical compression. Passive movements should only be begun, with great caution, after the joint has quite healed and is free from pain. For the after-cure, electricity, douches, and massage must be vigorously carried out.

It may be stated, generally, that in the slighter forms of gunshot injury to the *shoulder*, expectant treatment is justifiable. If a ball be lodged in the head of the humerus, and the bone much comminuted, or if there be considerable damage to the soft parts, primary excision should be performed, unless some additional severe injury contraindicate it. When the attempt to preserve the joint fails and suppuration ensues, the secondary period should be awaited, as no operation should be attempted in the intermediate stage. The after-treatment consists in immobilising the joint until healthy action is set up in the wound, and then an early employment of passive movement. During the Franco-German war ankylosis occurred in rather more than half the number of cases treated conservatively. In 10 per cent. there was free mobility, in the rest more or less impairment of motion. The final results would seem to prove that the function of the limb is better preserved after conservative treatment than it is after excision.

In the *elbow-joint* expectant treatment should, as a rule, be adopted, the mortality being only ten per cent. Excision gives a mortality of rather more than double that, and amputation about the same. In a few instances movement was preserved, but in the great majority ankylosis ensued. During the campaign of 1870 a free use of the joint took place in about 6 per cent. of the cases. Eleven recovered imperfect movement, while in 81 per cent. there was ankylosis. When the limb is in a good position a very useful arm will be the result. The limb should be immobilised on an angular splint, and the wrist kept midway between a position of pronation and supination. Care should be taken to prevent the fingers becoming stiff by early passive motion. Primary excision should be performed in cases of extensive fracture of the bones with injury to the soft parts. It may be either partial or complete. In this case it will be only requisite to remove the portions of bone that are damaged. Complete restoration of function is very rare, but a fair proportion recover, more or less completely, the use of the joint and power over the hand and forearm. In some there was a flail-joint, and many had to be amputated.

Wounds of the *hip-joint* are most severe; expectant treatment is the least dangerous course to pursue. Excision of the hip-joint is only to be performed as a primary operation, and in uncomplicated cases of fracture of the head or neck. The mortality is very great. Amputation at the hip is scarcely justifiable, judging by the terribly fatal consequences following it. Otis states that, in 49 cases of recovery after expectant treatment, in only one was it positively established that a fracture extended into the joint, and he doubts the accuracy of the diagnosis arrived at in many of the others. On the other hand, it would seem that recent experience has been more favourable. Langenbeck records 88 cases of wounds implicating the hip-joint treated expectantly, during the war of 1870, of which 25 recovered. In 39 cases of which the cause of death was known, 34 died from pyæmia and septicæmia. The American reporter pronounces in the most emphatic manner against expectant measures in gunshot fracture of the hip, the mortality of which he estimates amounts to 98·8 per cent. But the writer finds that after primary excision it was 96·9 per cent., and after primary amputation 91·4. Although expectant treatment is therefore, he thinks, to be condemned whenever direct injury to the articulation can be positively affirmed, the margin is very small indeed, and the difficulty of diagnosis admittedly often extreme.

Excision of the *knee-joint* has hitherto been attended with hardly any success in military surgical practice. Formerly amputation for gunshot injury to this joint was the universal rule; now, however, expectant treatment is recognised as the proper course to adopt, especially since the introduction of antiseptic methods. Bergmann reports 33 cases during the Russo-Turkish war, of which 20 made a good recovery and only one died. Sokolow has collected 140 cases of gunshot wound penetrating the knee, of which 100 recovered. If this be even approximately correct, it proves the mortality to be very much less than it ever is after amputation of the thigh. According to Heinzel's table of 117 cases of amputation of the thigh for gunshot injury of the knee, the mortality was 60 per cent. No doubt this list included all the more severe cases. Excision is still more fatal; the percentage of mortality amounted to 86·6 during the American war, and the experience of subsequent campaigns has been the same. We must emphatically pronounce against its performance as a primary operation during a campaign. The results of the excision of the knee performed by Nussbaum at Bazeilles, in 1870, where all but one died, sufficiently endorses this opinion.

Excision of the *ankle*, as a primary operation, is followed by very indifferent success, and, where the injury cannot be treated expectantly, amputation is the preferable course to adopt.

GUNSHOT INJURIES OF THE HEAD.—The proportion of these injuries varies much in different campaigns. It is always in excess in fighting from trenches and during sieges. In the Crimean war, one out of every three men killed in the trenches before Sebastopol was wounded in the head. On the average, injuries of the head constitute about 8 per cent. of all gunshot wounds. According to Gross's statistics, rather less than three-fourths are confined to the scalp, and one-fourth, or rather more, of the cases involve the skull and its contents.

Gunshot injuries of the head may be classified into :—

1. Scalp wounds without lesion of the bone.
2. Contusion of the bone with and without lesion of the scalp.

3. Gunshot fracture involving the outer table alone.

4. Isolated gunshot fracture of the inner table.

5. Gunshot fracture of both tables:—(*a*) Without depression, (*b*) with depression.

6. Gunshot fractures with perforation of the skull and penetration of foreign bodies: (*a*) those in which the projectile escapes, (*b*) those in which the projectile lodges.

Mortality after Injury of the Skull. In the 4,000 cases recorded during the American war the mortality after gunshot fractures of the skull was 60 per cent., while Chenu reckons the mortality in the Crimea at 74 per cent.

In the American report the following results are tabulated of the rate of mortality in different forms of injury:—

	Cases	Mortality
Contusions of the skull . .	328	16·8 p.c.
Fractures of outer table alone .	138	8·7 „
„ of inner table alone .	20	95·0 „
Linear fissure of both tables without known depression . .	19	36·8 „
Fracture of both tables without ascertaining depression . .	2911	64·6 „
Depressed fractures . . .	364	35·8 „
Penetrating „	485	85·5 „
Perforating „	73	80·0 „
Ecrasement or smash . . .	9	100·0 „
Contre-coup	2	50·0 „

A total of 4,350 cases, with 2,574 deaths, or about 60 per cent.

The following results followed operative treatment:—

	Cases	Mortality
Extraction of missiles in or within the bone . . .	175	48·3 p.c.
Ligations of bleeding vessels .	33	36·3 „
Removal of bone-splinters or elevation of the bone . .	454	39·0 „
Formal trephining	220	56·6 „
Operations for hernia cerebri . .	29	75·8 „

In regard to trephining, the primary operations were more than twice as fatal as those performed in the later stages. The operations proved most fatal when performed on the frontal bone, a little less in the case of the parietal and occipital, and least in the temporal; but of this last there were but few cases.

In gunshot injuries of the head the damage to the brain is localised, and symptoms of concussion are very rare. Symptoms of compression are more frequent as the result of gunshot injury. Depressed bone is the usual cause; it also occurs as the result of the presence of a foreign body, and from extravasation of blood between the dura mater and skull, upon the surface, or into the substance of the brain. According to Gross, extravasation of blood is the cause of the symptoms in one-half the cases. Hæmorrhage to a greater or less extent is present in every instance of severe fracture of the skull, especially when accompanied by extensive fissuring. The most frequent source of the bleeding is the anterior branch of the middle meningeal artery. This injury is by no means universally fatal. In a few cases trephining over the seat of injury has enabled the surgeon to secure the bleeding points, providing at the same time an escape for coagula. In several instances fractures of the parietal bone, involving laceration of the middle meningeal artery, have been discovered upon post-mortem examination to be united, as in the case of an English officer who was wounded in the parietal region at the storming of the Malakoff. After an interval he became unconscious and hemiplegic. Finally he recovered, but death took place three years later from pneumonia. On examination after death, a united fracture was found in the parietal bone, and a rupture of the middle meningeal artery close to its division into its anterior and posterior branches.

The other causes of compression or interference with brain function are traumatic meningitis or encephalitis. Suppuration occurs in a large number of cases. In about 5 per cent. it is between the dura mater and the bone. It is the result of meningitis in about 25 per cent., and in the form of a localised suppuration or abscess in the substance of the brain in about 70 per cent. of the cases. The symptoms of compression, the result of depressed bone, are often late in making their appearance, and as the result of inflammatory changes seldom arise before the tenth day. When they do occur immediately in cases without manifest depression of skull, they must be due to the extravasation of blood within the cranium. If they supervene within a few hours after the receipt of injury, reactionary hæmorrhage is probably the cause. When they take place after an interval of ten days or longer, they are dependent on inflammatory changes or the formation of an abscess.

The symptoms do not essentially differ from those observed in cases of injury to the skull from other causes. The progress and result depend entirely on the disappearance or removal of the cause. Surgical means may be employed to elevate a depressed portion of bone, remove a foreign body, provide an escape for hæmorrhage, or to seek for and evacuate pus. On the other hand, a blood-clot may become gradually absorbed, and it must be remembered that the brain is able to accommodate itself to a considerable diminution in the capacity of the cranium. The longer the condition of compression is allowed to endure, however, the greater is the risk to the patient's life. *See* Brain, Compression of the.

The symptoms of injury to the brain vary with the position of the wound. In the upper part of the calvaria a gunshot wound of the brain often produces paralysis of the lower extremities; sometimes both upper extremities and the lower of the opposite side are affected. Injury involving the region of the motor centres may produce paralysis of the motor oculi, facial paralysis, or paralysis of groups of muscles in the extremities, consciousness remaining unimpaired. Aphasia may be present, either alone or in association with facial paralysis, or paralysis of the upper extremities may be associated with agraphia. Bergmann, who has devoted much attention to this subject, observed areas of localised loss of sensation after gunshot injury, the motor power remaining intact, especially in injury of the parietal region. Clonic spasm of the muscles, involving certain groups, or sometimes extending over the whole of the opposite side, generally indicates injury to the cortical substance. Paralysis and spasm are alike uncommon after injury involving the occipital and temporal regions. Injury to the medulla oblongata may be recognised by the change in the respiratory function, Cheyne-Stokes respiration, slow pulse, and a sub-normal temperature. When the cerebellum is involved, there will be faulty co-ordination of movement. The paralysis of certain cerebral nerves may serve to localise injury involving the base of the skull. The symptoms, however, are often obscure, and an exact diagnosis will always be difficult to arrive at. Injury to the base or sides of the brain is more dangerous than to the upper surface.

Hernia cerebri is not an uncommon sequence of gunshot injury to the brain. It generally takes place after an interval, and is the result of the increase of intracranial pressure or the formation of abscess. Generally it is small, but it may attain the size of a man's fist. The condition is a very fatal one, 44 patients dying out of the 55 cases recorded during the American war. The majority occurred after the secondary removal of fragments of bone. The diagnosis is easy, as a pulsating tumour, covered by granulation-tissue, is observed projecting from the wound. Simple treatment should be adopted, the surface kept as pure as possible, protected from external injury, and cicatrisation thus promoted. In favourable cases the inflammatory swelling subsides, and the tumour recedes within the skull. A fatal issue is the rule, from extension of the brain-inflammation, or the formation of an abscess, which is so frequently associated with hernia cerebri. The tumour should never be sliced off nor pressure be applied to it. The knife, caustics, or écraseur are alike inapplicable. *See* Hernia Cerebri.

The great majority of gunshot injuries to the brain terminate in a fatal suppurative meningitis. The most common period of its occurrence is from the second to the sixth day after the injury. Bergmann found, however, extensive suppuration actually present in cases which had survived only thirty-six hours. In almost every instance this is associated with septic changes occurring in the wound. At a later period the disease may originate in a suppurative periostitis or ostitis of the broken fragments, thrombosis and phlebitis of one of the sinuses of the dura mater, or in abscess of the brain. The period of its occurrence is quite indefinite.

Cerebral abscess is a common result of gunshot wounds of the head. Most frequently it occurs from two to three weeks after the injury. It may be the consequence of a contusion of the brain, the presence of a foreign body, or more often of purulent inflammation of the skull, or necrosis of a fragment of bone. It may form either in the cortical or white substance, and vary in size from a pigeon's egg to a small orange. The wall of the abscess is irregular, and the contents may be either green, brown, or yellow. The symptoms are indefinite and the diagnosis difficult. Headache is usually present, often of excessive severity; fever, with very irregular exacerbations, and, later on, convulsions and paralysis.

In the treatment of gunshot fracture of the skull, mental and bodily rest is necessary. Transport should be avoided, the secretions regulated, and easily digestible food administered. Simple fractures are, of course, very rare, and must be treated expectantly unless symptoms of compression supervene. In compound fractures antiseptic precautions are of the first importance. Loose fragments should be extracted, and any that are depressed elevated or removed. If a foreign body have penetrated deeply it must be let alone, as the search for it would entail extensive damage to the brain. Projectiles and foreign bodies which can be readily got at should be removed with great care, in order to avoid further injury to the brain or its membranes, or hæmorrhage.

In perforating wounds of the skull, it may be necessary to trephine in order to reach fragments of the internal table, which is always more extensively comminuted and depressed. The bullet at the same time may be discovered. In cases where fracture of the internal table only is suspected, a diagnosis cannot be made, and expectant treatment must be adopted. In contusion or wound of the brain, the chief thing is to purify the part thoroughly, keep the patient at rest on a low diet, and apply cold to the head. Beyond this, there is in the first instance but little to do, and later on but little can be done. Should an abscess form, the evacuation of the pus affords the only prospect of recovery.

In cases of compression, when the symptoms are due to hæmorrhage, an attempt may be made to discover the source of the bleeding, and for this purpose the external wound may be enlarged and also that in the bone. The blood-clot, however, should not be interfered with. In progressive hæmorrhage blood-letting is sometimes useful. The ligature of the common carotid on the injured side is an operation likely to be of only temporary benefit. Where the symptoms of compression depend on depressed fracture, the depressed fragments of bone should be elevated or removed.

GUNSHOT INJURIES OF THE SPINE.—In these, as in head injuries, the matter of first importance is the degree of damage to nerve-tissue. Injury of the spine is very generally complicated with wounds of the chest, neck, or abdomen. Otherwise the mortality varies with the part of the spine wounded. The higher up the injury is, the greater the mortality. Gunshot fracture of the spine is always serious, especially when it involves the bodies of the vertebræ. When recovery does take place, the transverse or spinous processes are alone affected. Concussion of the spine and temporary paralysis may be produced by shell-explosion, but frequently some further injury has been inflicted. Wounds of the spine from heavy projectiles nearly always prove rapidly fatal. Very few injuries of the cervical spine have recovered, and in these the injury was confined to the spinous processes, and was followed in all the cases by stiffness of the neck, with paralysis of the arm.

Associated with gunshot injury of the dorsal spine there is frequently a penetrating wound of either the chest or abdomen, followed by speedy death. When the processes or laminæ only are involved the fatal termination is protracted, death taking place from secondary causes. Recovery most frequently ensues in fractures of the lumbar spine. Seventy cases were observed in the American war, but in these the processes of the vertebræ were the parts injured. In many, paralysis continued for the remainder of life; in others there were repeated abscesses, exfoliations of bone, and sinuses. In a few cases the bullet lodged either in the spinal canal or the bone. In three-fourths of the cases of fracture of the spinal column the cord was injured at the same time. There are, however, no reliable statistics of the frequency of the various kinds of injury. The symptoms may be immediate or secondary, and their character will depend on the portion of the cord injured. They may come on after an interval of weeks, months, or even years.

In some cases the cord will be merely contused, a kind of injury more frequent than is commonly supposed, producing symptoms dependent on the particular region involved. In other cases the cord may be compressed by an extravasation of blood, or a fragment of bone, or an embedded projectile. Here, also, the symptoms will depend on the particular part which has been wounded. In a few cases, when the cord has not been permanently damaged, if the cause of the compression can be removed recovery may follow; but in those cases which do not terminate fatally the usual result is permanent paralysis, complicated by bedsores and chronic catarrh of the bladder. When the injury is inflicted from behind, the gunshot track will be short; but from in front it is necessarily long, and the nature of the injury difficult to diagnose, complicated as it probably will be with perforating wound of the thorax or abdomen. The cord may be either partially or completely divided, and there will always be more or less extravasation of blood. When the cord is completely divided, the reflex excitability will be increased. The nature and extent of the paralysis are generally sufficient to establish a diagnosis.

With injury in the region of the lumbar spine there will be loss of sensation and motion in the lower extremities, retention of urine in the first instance, followed by stillicidium, incontinence of fæces, and priapism. The upper extremities are unaffected.

In the dorsal region there is dyspnœa from paralysis of the abdominal and intercostal muscles, and if the lesion be in the upper part of dorsal spine, the upper extremities are involved as well. The temperature in the paralysed parts is at first increased. The functions of the bladder and rectum are generally interfered with; priapism is infrequent; bedsore is prone to form at all points where pressure exists.

In the cervical region the upper and lower extremities are paralysed, there is difficulty of swallowing, difficult respiration; inequality of the pupils is occasionally observed; there may be increase of temperature in the paralysed parts.

Injury to the cord itself is fatal sooner or later almost without exception,—in the upper cervical region, after a very few days, from interference with respiration; in the lower, seldom later than the first week. Only in the lumbar region may the patient live a few months. Death generally takes place from suppurative meningitis or from exhaustion.

Gunshot Injury of Nerves.—Wound of the cerebral nerves is very rare, except in conjunction with other severe injury. Branches of the fifth are sometimes wounded, and also the facial nerve. The pneumogastric has been sometimes divided in the neck, generally with an immediately fatal result, from wound of the adjacent vessels; otherwise the respiration becomes slow and laboured, the voice is lost, the pupil on the injured side contracted, and pneumonia supervenes.

In wounds of the extremities, the great nerve-trunks, as a rule, escape; they are elastic and protected by their sheath, but one of them may be lacerated, completely divided, or more or less contused. In these cases, if any foreign body be found pressing on the nerve, it must be removed. If the nerve be wholly or partially divided, the seat of injury should be exposed; the injured part must be excised, and the cut ends sutured together with fine carbolised silk, as was first recommended by Nélaton in 1864. It does not seem a matter of much importance whether the suture be passed merely through the sheath, or through the nerve-substance as well. Restoration of function has followed in a large proportion of cases. In some, atrophic changes have occurred even after apparent recovery. Where the first attempt ends in failure, a second may be made. Galvanism should be employed at an early period to stimulate the atrophied muscles. The frequency of injury to the nerve-trunks is much greater in the upper than the lower limb. In the latter the sciatic nerve is most frequently damaged, in the former the brachial plexus or median nerve.

Gunshot Wounds of the Eye.—During the Franco-German war these amounted to 10 per cent. of the total number of wounds. In regard to impairment or loss of function the vulnerability of the eye stands high. It may be directly injured by the projectile, or contused or burst through the medium of adjacent parts. If penetrated by a pellet of shot or fragment of bullet, the sight is invariably lost, either by the escape of the contents of the eyeball through the wound, or the subsequent intense inflammation which sets in. The sight is, as a rule, destroyed by gunshot injuries; a less severe injury may induce traumatic cataract, iritis, or glaucoma. Sympathetic inflammation of the other eye is a frequent and serious result of damage to one. Gunshot injury, as a rule, destroys the eye, and enucleation becomes necessary to avert the occurrence of sympathetic ophthalmia.

Gunshot Injury of the Ear.— These injuries are very rare, and are usually associated with damage to other organs. In some cases the sense of hearing is temporarily or permanently damaged by the explosion of shells in close proximity, causing rupture of the membrana tympani. In a few cases the mastoid cells have been opened, or a fracture traverses the middle ear. The ear has frequently been injured by wounds inflicted from the mouth. Inflammation and suppuration in the bone are frequent and dangerous consequences, as the inflammation may spread inwards at any time to the brain. The external ear may be torn off in part or altogether. The detached portion should be sutured. After gunshot injury, however, the damaged portion generally sloughs off.

Gunshot Wounds of the Face.—Very extensive wounds of the nose and cheek, followed by great deformity, are the result of gunshot injury. Much may be done to relieve the condition of the patient by subsequent plastic operation. Lacrymal fistula may occur, or fistula from injury to Steno's duct, or facial paralysis from division of the portio dura. Gunshot fracture of the upper jaw is a serious accident. Death from hæmorrhage frequently occurs in the first instance, and pyæmia and erysipelas, sinuses with prolonged discharge, and exfoliation of necrosed bone are common after-consequences. Gunshot fracture of the lower jaw is three times more frequent, and in some respects more serious, than fracture of the upper jaw. The large number of cases recorded, however, in the American reports, prove the risk of life to be about equal in the two forms of injury, the mortality after gunshot wound of the upper jaw being 8·1 per cent., and of the lower jaw 8·3.

Any loose fragment should in the first instance be removed; a piece of moulded pasteboard applied over the chin and secured by a four-tailed bandage. Suppuration is always abundant, but extensive necrosis is rare. The mouth should be frequently washed out; iodoform is an excellent application in all cases of buccal wound.

Secondary hæmorrhage has proved exceedingly frequent and difficult to control, after injury to the face. The carotid artery has been tied in many instances, but the result has been most unsatisfactory, the hæmorrhage usually recurring and causing a fatal termination. The mortality after ligature amounts to more than 70 per cent. In a few cases the external carotid has been ligatured successfully.

Gunshot Wounds of the Neck.—Those of the lateral aspect may involve the great vessels; the pneumogastric or sympathetic nerves from behind. Unless deep enough to involve the spine, a gunshot wound here is comparatively unimportant. In front the hyoid bone, the larynx or trachea, may be injured; and in a few cases the pharynx or œsophagus. Where the air-passage is opened the symptoms are evident. Air escapes from the wound, and probably there is emphysema in the neck. Power of speech would be lost, there would be difficulty of breathing and swallowing, and risk of asphyxia from inflammatory swelling, or from deep-seated inflammation in the neck. Laryngeal or tracheal stenosis may occur from subsequent cicatricial contraction, necessitating tracheotomy and the permanent wearing of a canula. The prognosis is in these cases unfavourable.

In all cases of injury of the larynx and trachea the patient must be kept quiet; sudden œdema may necessitate tracheotomy. When a foreign body in the neighbourhood of these organs interferes with respiration, and cannot be safely removed, the earlier tracheotomy is done the more favourable is the prognosis. Superior tracheotomy is the easier method. An elastic catheter, a drainage-tube, or the end of a large silver catheter, may be used in case of need in place of a canula.

Gunshot wound of the œsophagus is very rare, and nearly always associated with damage to other important structures in the neck. The bullet may traverse the tube, making two openings in it, or tear a portion completely away. Fracture of the spine, and injury to the cervical vessels and nerves are frequent complications. Swallowing is usually very difficult or impossible. The prognosis is bad, death taking place from hæmorrhage, asphyxia, or, at a later period, from diffuse cellulitis in the neck, pneumonia, secondary hæmorrhage, or exhaustion. A few have recovered with a permanent fistula and traumatic stricture. In gunshot wounds of the œsophagus the nutrition of the patient is the chief difficulty. He should be fed by the mouth if possible, or else through the wound with a tube.

Gunshot Injuries of the Thorax.—The proportion of these to the total number of wounds varies in different wars from 1 in 10 to 1 in 16. The latter was the proportion in the Crimea. In the American war it was 1 in 12. In 1870, before Metz and Strasburg, it was 1 in 12. The ratio of non-penetrating to penetrating wounds varies from 25 to 53 per cent. In the Crimea penetrating wounds amounted to 31 per cent. of the chest wounds, during the American war to 42 per cent., and among the Prussian wounded in 1864 to 53 per cent. During the war of 1870–71 different observers estimated the percentage at from 44 to 89 per cent. The nearer the hospital is to the battlefield, the more numerous the penetrating wounds of the chest received into it will be.

In uncomplicated gunshot wounds of the superficial parts covering the chest the mortality is very small, probably not more than one per cent. They seldom occasion much pain or cause implication of the lung. They heal slowly, on account of the mobility of the chest-wall, especially when of the variety called seton wounds. It is not uncommon to find the ball or fragments of cloth or other foreign substances lodged. In a certain number of cases the ribs were injured without opening the pleural cavity, or directly injuring its contents. In many instances these cases did well, but they were often complicated with pleuritis or pneumonia from the irritation of the fractured bone, or abscess and necrosis taking place. The scapula and clavicle as well as the ribs may be fractured without the pleura being penetrated.

Penetrating Wounds of the Chest.—Penetrating wounds may take place either with or without fracture of the ribs. The projectile, when small, may pass between two ribs without injuring them. This was found to be not infrequently the case with the chassepôt bullet during the war of 1870, but the needle-gun bullet invariably fractured the ribs, and so did the Russian Berdan ball. Fracture of the ribs at the entrance-wound takes place in the majority of cases, and greatly enhances the severity of the injury, as fragments of bone are generally carried in with the ball and seriously damage the lung. At the wound of exit fracture of the rib is of less importance. In a few cases the pleura has been found wounded without injury to the lung. Several cases of this kind were observed during the war of 1870. It is probably caused by the bullet striking tangentially or at a slow velocity. Klebs mentions a case in which the ball traversed the right pleural capity, entering in front on a level with the fourth rib and emerging opposite the tenth, behind, without wounding either the lung, pericardium, or diaphragm. The nature of such an injury would be impossible to diagnose during life.

Penetrating gunshot wounds of the chest may not only be associated with fracture of the ribs, but very frequently with fracture of the scapula as well; less commonly, the sternum or clavicle. Fractures of these bones are very serious complications, as fragments of them often lie embedded in the lung and produce most extensive suppuration. The bullet may traverse one pleural cavity from side to side, or both pleuræ. It may lodge in the lung-tissue, the wall of the chest, or the body of a vertebra; or pass through the diaphragm and wound the abdominal viscera.

The diagnosis of a wound penetrating the pleural cavity and wounding the lung, which it does in the great majority of instances, is generally sufficiently clear. Air passes in and out through the wound. There will be always more or less dyspnœa present, and in some cases this is exceedingly urgent. Hæmoptysis is by no means a constant symptom of wounded lung. Probably it does not occur in more than one-fourth of the cases; indeed during the American war it was, it is stated, present in only five or six per cent., but when observed it will afford valuable, although by no means conclusive, evidence of the nature of the injury. Pneumothorax is always present, and collapse of the lung, unless the pleural surfaces be adherent at the seat of injury. Hæmothorax is an almost constant consequence of injury to the lung. It is very variable in amount; in many cases it will be very slight, from the collapse of the lung closing the wounded vessels, in others the blood may fill the pleural cavity.

The symptoms of hæmothorax are frequent laborious respirations and orthopnœa. There is urgent anxiety and distress, the patient turns about or can only rest on the injured side; great sense of constriction around base of chest. There is also evidence of loss of blood, pallor, cold surface, frequent small pulse, or there may be complete collapse. The percussion note is dull and the respiratory murmur absent, the ribs separated, the hypochondrium prominent. Surgery has hitherto availed but little to relieve the urgency of the symptoms. The question of reopening the wound or keeping it closed is a disputed one. Cold should be applied to the chest and warmth to the extremities. Only when the symptoms become very urgent should the wound be reopened. The intrathoracic pressure may of itself stop the bleeding. Subsequent symptoms must be treated as they arise. Emphysema after penetrating wounds is uncommon, occurring perhaps once in every 200 cases. It is usually limited to the neighbourhood of the wound; very rarely is it of any great extent.

The fatality of penetrating gunshot wounds is very great. A large proportion quickly die upon the field. Where both pleural cavities are involved, or the heart or its great vessels wounded, death will be always instantaneous. Amongst those treated in hospitals, more than half terminate fatally in the first few days from acute inflammatory processes in the lung and pleuræ; others who survive this period die from fever and exhaustion, the result of the septic changes in the fluid contained in the cavity of the wound; while in many cases of so-called recovery there are sinuses constantly discharging, necrosis of portions of rib, empyema, chronic cough, and other evidence of lung-mischief. The mortality probably is not less than 70 to 75 per cent.

In a few favourable cases the wound will heal under a scab, and this led to the practice, proposed by Surgeon Howard during the American war, of hermetically sealing perforating gunshot wounds of the chest. All accessible foreign bodies and fragments of bone having been removed, the edges of the wound are pared, sutured together, and covered with lint saturated in collodion. In 69 cases treated in this way, the lung being wounded in all but 15 of them, recovery took place in 27—a mortality of 68 per cent. The mortality is not, perhaps, excessive, especially as two-thirds were believed to be associated with lung-injury; but the American reporter thinks that, in many of these cases, the evidence of wounded lung and perforation of thorax is quite insufficient; besides, in many of the so-called cases of recovery, interminable sinuses, necrosis, empyema, chronic cough, and other evidence of lung-mischief remained. Sometimes occlusive treatment relieved the dyspnœa and the more urgent primary symptoms, with temporary improvement as a result. But the careful examination of the evidence proves that this plan has not lessened the mortality, and has been sometimes attended by disastrous consequences. Fragments of clothes and other foreign bodies are sewn up, and blood and fluid accumulate and decompose in the interior.

The fatality of gunshot wounds really perforating the lung is very great. In unfavourable cases pneumonia follows more frequently than is commonly supposed, though by no means invariably, especially where foreign bodies have entered and air gains free admission. It is very fatal when it takes place. In 20 autopsies by Klebs of gunshot wound of the lung, pneumonia was only once observed. Probably this is due to the collapse of the organ. In other instances an abscess develops which may open into a bronchus and the patient recover, or burst into the pleural cavity and produce septic pleuritis. Gangrene of the lung is rare. Inflammation of the pleura is often more serious than inflammation of the lung, as it so generally assumes a septic form, or an empyema develops, accompanied with hectic fever and rigors.

Hernia of the lung, the result of gunshot injury, is very rare. Only 7 examples are noted amongst 20,000 cases of chest wounds. No case was observed during the Franco-German war. The explanation of its occurrence is difficult and unsatisfactory. The tumour moves with the act of respiration. Reduction without excision cannot be accomplished. An intercostal omental hernia may be mistaken for pneumatocele. The better course is to leave the tumour alone without active surgical interference. It may be protected subsequently with a hollow pad, or retract spontaneously. Cases of hernial protrusion of the liver and omentum have also been observed. Wounds of the diaphragm never unite. If recovery ensue, a diaphragmatic hernia will occur.

Immediate Treatment of Gunshot Injuries of the Chest.—If the wound is small, the injury to the bone not great, and no foreign body has been carried in, the best course will be to treat by antiseptic occlusion. If extensive, with much injury to the bone, loose fragments and foreign bodies are to be removed, counter-openings made, free drainage provided for, and antiseptic dressing applied. If this fail, frequent washing out of the cavity with warm salicylic solution must be adopted. The same rules apply for the extraction of foreign bodies here as elsewhere. If the projectile be lodged in the wall of the chest, it may be removed; if within the cavity, no attempt to extract it or to examine the wound with a sound should be made.

The patient must be kept very quiet, in a moist, warm atmosphere. A half-sitting posture is a good one, with the body turned to the injured side. Transport is impracticable. Formerly, copious blood-lettings were practised; but this is undesirable, unless the dyspnœa go on increasing and is not relieved by subcutaneous injections of morphia. The quantity of blood removed should be in proportion to the strength of the patient. In constantly increasing hæmothorax bleeding has been practised, but it is better to lay the patient on the injured side, close the wound, and apply ice to the chest. To open the cavity and evacuate the blood would probably renew or increase the bleeding. If the extravasation decompose, free incisions and drainage must be resorted to. Opium administered internally gives great relief in these cases. Emphysema does not often cause great dyspnœa; it may be relieved by small punctures. Pneumothorax had best be let alone; in extreme cases the wound may be opened again.

Hæmoptysis requires rest, nourishing diet, styptics, and opium internally, and cold to the chest. Serous effusions are seldom observed, except after contusions. The treatment will be expectant in most cases, or simple puncture if the effusion be great and cause severe symptoms, or is not absorbed after a few weeks. Traumatic empyema is more common. For this condition free drainage and antiseptic irrigation must be practised. Generally two openings are required. Excision of the ribs is a very old operation, seldom applied to cases of military surgery as a primary operation. It will often prove useful in cases of empyema. A piece of one or more ribs may be excised for the purpose of securing a freer opening; the cavity must be daily washed out with warm salicylic solution and antiseptic protection given. Sometimes the cure is rapid; generally it is slow, with associated curvature of the spine and falling in of the chest-wall. A fistula often remains open for a long period. In two instances in which the writer treated a gunshot penetrating injury of the chest by excision of a rib for subsequent empyema, the result proved most satisfactory. *See* EMPYEMA.

GUNSHOT INJURIES OF THE ABDOMEN.—These may take the form of contusion, or of wound involving the parietes only, or, lastly, be penetrating, a variety which forms more than half the total number. The projectile may penetrate and lodge, traverse the abdomen and emerge by a second wound, or become arrested at some point beneath the skin. As a general rule the viscera will be injured; in a few cases they escape. Abdominal wounds may be complicated with injuries of the chest or pelvis. Contusions occur from the blow of a spent shot, and may occasion extravasation in the abdominal wall or cavity. Laceration of the viscera occurs in about 1·5 per cent. of these cases. The liver or spleen is the organ generally affected. The only treatment is an expectant one, as an accurate diagnosis is scarcely possible. Wounds of the parietes may be simple or severe. Their chief importance consists in an associated injury to the viscera, or the spread of subsequent inflammatory processes in the interior of the abdomen.

The symptoms of injury to the intestine are often indefinite. The contents of the bowel may or may not escape externally. There is always more or less extravasation into the abdominal cavity, which usually sets up a rapidly fatal peritonitis, accompanied by great pain, tympany, vomiting, hiccough, and collapse. In some few rare cases the extravasation may become encapsuled, and an abscess forms, followed by fæcal fistula. The diagnosis of the exact extent of the injury is scarcely possible, short of making an abdominal section. The great majority prove fatal in twenty-four or thirty-six hours. During the American war the mortality was 83 per cent.

Gunshot wounds of the large intestine do not present any special symptoms. They are less dangerous than those of the small intestine, because the injury is sometimes extra-peritoneal, and, especially in the descending colon, recovery may ensue after the formation of a fæcal fistula. Recovery is rare after injury of the ascending or transverse colon. Gunshot wounds of the rectum are not uncommon. They are usually complicated with fractures of the pelvis or wound of the bladder. The writer remembers cases of this kind in which fæcal matter escaped from the posterior wound and urine from the anterior. Recovery sometimes takes place, but diffuse pelvic suppuration is apt to be induced, and both primary and secondary hæmorrhage are very frequent. In cases which do survive, fistulous openings persist for a long period.

Gunshot wounds of the stomach are usually immediately followed by vomiting of blood, severe collapse, epigastric pain, intense thirst, hiccough, and extravasation of blood; the escape of the contents of the stomach will depend on its empty or distended condition at the moment of injury. The stomach is seldom wounded alone, the lungs and diaphragm, liver, spleen, or colon being generally also wounded. The injury, as a rule, proves rapidly fatal. A few well-authenticated cases of recovery are recorded. Six are mentioned in the American report, and Fischer exhibited a stomach at the meeting of German surgeons in Berlin, with a circular cicatrix caused by a bullet in the central part of the anterior and posterior surfaces. The patient died of an attack of cholera two years after having recovered from a gunshot perforation of the stomach. In some cases, as that of Alexis St. Martin, recovery is followed by a permanent gastric fistula.

Gunshot Injuries of the Liver.—This organ may be subcutaneously ruptured by a blow from a heavy projectile. Bullets may produce wounds of almost any extent or variety. The convex surface is generally most frequently injured, and in some cases these wounds may be recovered from. Wounds of the concave surface are almost immediately fatal. Death occurs from severe hæmorrhage or rapid peritonitis. In cases which are not immediately mortal an abscess will form. The older surgeons considered this injury as fatal as a wound of the heart; but Otis has proved that in a few instances of undoubted injury to the liver recovery has taken place. Generally a fatal result sooner or later ensues, as the injury is seldom confined to the liver itself. Where the gall-bladder is wounded death has almost always followed.

Gunshot Wounds of the Kidney are not very common, from its deeply-placed, protected situation. As in the large intestine, the injury may be either intra- or extra-peritoneal. The wound may involve the cortical portion, the pelvis, the renal vessels, or all of these parts. The termination is generally fatal from peritonitis and hæmorrhage, but a number of recoveries are recorded. Urinary fistula and exhausting suppuration continue for a long time. The prognosis is bad, although the injury is probably less fatal than that of the liver or spleen. The chief symptoms are hæmorrhage from the wound, blood in the urine, shock, pain in the loins and testicle, and an area of dulness in the region of the kidney. Persistent vomiting is frequent.

In the first instance expectant treatment is to be recommended for wounds of the kidney. Many cases of injury to the kidneys during the last wars have recovered. Care must be taken that the secretions are allowed to escape freely, the interior of the wound must be cleansed with carbolic injections; perinephritic abscesses diagnosed as early as possible and opened by lumbar incision. Where the suppuration surrounds the entire kidney, or septic symptoms appear, it may be best to extirpate the organ. *See* NEPHRECTOMY.

GUNSHOT WOUNDS OF THE BLADDER may occur in those parts invested by peritoneum, or be extra-peritoneal. The former prove rapidly fatal; of the latter a certain proportion recover. Excluding those who die on the field, 65 deaths (according to Bartels) took place in 285 cases. The wound may either traverse or merely penetrate the bladder. Wounds from before backwards and from behind forwards occur with almost equal frequency. The latter appears to be the more dangerous, and a traversing wound than a single opening. All cases in which the peritoneal cavity was involved proved fatal, and a large proportion of the others died from urinary infiltration and septic poisoning. About one-half are complicated with fracture of the pelvis, which considerably increases the risk of life. The pubic bone is most frequently involved, next the sacrum, then the ilium, and least frequently the ischium. In many cases the projectile, a piece of clothing, or fragment of bone lodges in the bladder. If recovery ensue, these become encrusted with triple phosphates and give rise to symptoms of calculi. Gunshot wound of the bladder is attended by the escape of urine mixed with blood from the wound, by vesical tenesmus, great pain in the abdomen, groin and testicle; fever sets in on the second or third day, and urinary infiltration followed by septic suppuration takes place in the pelvic cellular tissue.

It is essential in the treatment of bladder wounds to make provision for the escape of urine; otherwise we adopt expectant treatment. The rapidly fatal nature of the injury when the peritoneal cavity is involved does not permit an exploratory operation to be performed. A permanent catheter should not be left in the bladder, because it induces bladder-catarrh and ulceration of the mucous membrane. Fistulæ often persist after recovery, and are difficult to treat or cure.

A foreign body in the bladder should be removed at once. Its presence, however, is often not recognised till a later period. Then it may be removed through the wound after enlarging it, or by lithotomy. The function of the bladder is often permanently damaged.

Mortality.—In the field-hospitals the mortality from perforating gunshot wounds of the abdomen is at least 80 per cent., and a large number die from injury to the abdomen on the field. In respect of mortality, the individual organs stand in the following order:—The most fatal is injury of the small intestines, next the stomach, the spleen, large intestine where invested by peritoneum, liver, kidneys, large intestine outside the peritoneum, lastly the rectum. Hæmorrhage is the most frequent cause of death; some appear to die from shock. If the first period be survived, septic absorption and general peritonitis, still later secondary hæmorrhage and exhaustion, are the causes of a fatal termination.

Treatment of Injuries of Abdomen and Pelvis.—Gunshot wounds involving the parietes only should be treated antiseptically, as similar wounds elsewhere. When the peritoneum is simply opened, an effort should be made to close it by suture. Any uninjured organ which may protrude should be cleansed and returned. Protrusion of the abdominal contents after gunshot injury is very rare. The traumatic peritonitis which so commonly ensues may be treated by ice, calomel and opium internally, but this will be all but useless. Effective drainage, combined with antiseptic washing out of the abdominal cavity, making, if necessary a free incision through the parietes for the purpose, affords better prospects, but hitherto these injuries have been almost uniformly fatal. Isolated collections of pus should be freely opened and drained. Simple blood extravasation should not be interfered with.

When the stomach is wounded, the hæmorrhage is always most serious, and there is the additional risk of extravasation of its contents. When a diagnosis can be made, the existing wound in the parietes should be enlarged, or an incision of sufficient length made in the linea alba; then after the wounded organ is fully exposed the stomach must be drawn out and the wound in it closed with a double row of sutures; the peritoneal cavity must afterwards be thoroughly cleansed with a warm antiseptic solution. The external wound can now be sutured, and the part dressed antiseptically. Nothing should be given by the mouth for some days, and the strength maintained by nutrient enemata. Opium must be freely administered. Although in civil hospitals operations on the stomach have proved successful, a like result is improbable in time of war. Recovery is, however, possible. A gastric fistula is an unfavourable result, as it is exceedingly difficult to cure, and interferes with the nutrition of the patient. A flap of skin may in some cases be transplanted in order to close it, or the abdominal wall incised, the adherent stomach separated, and the opening in it closed by Lembert's sutures, then the margins of the fistulous track in the parietes must be pared and united. Several cases of recovery are recorded after this operation. It was first performed by Billroth.

Gunshot wounds of the intestine seldom come under treatment, or only too late for effective interference. Where the injured intestine is prolapsed and the wound in it small, we may close the opening by suture, and carefully cleanse all the parts before reduction. In cases where an injury to the intestine is diagnosed, the patient should no longer be left without an effort made to preserve life. An incision must be made in the median line, or the existing wound may be enlarged sufficiently and a search made for the injured bowel. This must then be dealt with according to the amount of damage it has sustained, either by simple suture of the opening when it is small, or when more extensive by resection of the damaged portion of bowel and suture of the cut extremities together by Lembert's method. It will be necessary to take care not to detach the mesentery from the intestine and thus rob it of its vascular supply. Where any considerable part of the intestine requires removal a V-shaped portion of mesentery must be excised. Then the edges of the bowel and the cut margins of the mesentery are sutured together, every portion of the wound purified, the injured part restored to the abdominal cavity, and the external wound closed. *See* LEMBERT'S SUTURE.

All parts of the abdominal cavity into which extravasation might have occurred must be thoroughly purified with clean sponges dipped in a warm 1 per-cent. carbolic solution. Thorough cleansing of the abdominal cavity and the intestine is an important part of the operation. If this can be perfectly accomplished the external wound can be closed without inserting a drain, but drainage is, as a rule, necessary.

The operation of suturing a piece of wounded intestine and, still more, resecting it, lasts a long time. The patient must be kept warm, the intestine protected by compresses wrung out of warm 3 per cent. carbolic solution, frequently changed. Afterwards ether injections may be given to prevent shock, and opium. Nothing should be taken by the mouth for the first few days except a little milk and ice. Nutrient enemata must be administered. After the fifth day milk, soup, and a little bread may be taken, and in a week or ten days ordinary simple food.

The most dangerous period is from the third to the fifth day, when the sutures cut their way out. Union takes place by fibrinous exudation and adhesion of the adjacent omentum and loops of intestine. It is only as a rare exception that such a measure as this can be carried out successfully or even attempted in cases of gunshot injury; but we are justified in making the attempt rather than permit the inevitably fatal result to take place.

Artificial anus sometimes persists after recovery from a gunshot wound of the intestine. It is a painful infirmity, and, if high up in the intestine, interferes very seriously with the patient's nutrition. A fistula which is not associated with much loss of substance of bowel, such as a pistol-bullet may produce, can spontaneously close, or with the aid of a plastic operation. Where there has been loss of substance the éperon of Dupuytren will form. The fistula may sometimes be cured by dividing it; otherwise the abdomen must be opened, the ends of the intestine detached from the abdominal wall, resected and sutured together as before described, and the external wound then closed. In civil practice these operations have been followed by a large measure of success. *See* ARTIFICIAL ANUS.

Several times during the war of 1870 a fistulous communication between the bladder and rectum was observed to follow a wound traversing the pelvis. A spontaneous cure sometimes occurred. In others the fistula persisted. In some of these the rectum has been incised towards the coccyx to afford room for more ready access to the fistula. The margins of the fistula may be then excised and deep silver-wire sutures inserted, superficial silk ones being introduced as well. The result is uncertain. In cases of failure an opening in the descending colon will afford much relief. When the bladder and small intestine communicate abdominal section is the only means of dealing with the fistula. The adhesions may then be separated and the openings closed by suture. A portion of intestine may have to be excised as well. An operation of this kind is of course very severe, difficult, and dangerous to life, and the cases in which it is likely to be undertaken must be very few.

GUNSHOT WOUNDS OF THE GENITAL ORGANS are comparatively rare. The body of the penis may be traversed by a bullet without injury to the urethra, or the urethra alone may be divided by the ball. In most cases there is also a wound of the thigh, scrotum, testicle, or perineum. In one case the bullet lodged in the corpus cavernosum, and when this body is wounded there is always severe bleeding. After recovery the cicatrix will interfere with erection. When the urethra is wounded urination will be difficult, or there may be complete retention; the tube may be partially or completely divided. Infiltration of urine generally takes place. The mortality is considerable—about 20 per cent.—and when recovery takes place urinary fistula and traumatic stricture are the inevitable results. When the urethra is torn through by a bullet, a catheter should be introduced if there be retention; if this be impracticable, external urethrotomy may have to be performed. It is often very difficult to find the proximal end of the urethra, which will be retracted or buried in the tissues. A catheter should never be left for a long time in the bladder, as it excites cystitis. Urinary fistulæ are difficult to cure. Various forms of plastic operation have been devised for the purpose. Scrotal wounds are common, and the testicle is at the same time more or less damaged; inflammation is set up in it, and it may either atrophy or its secreting structure become destroyed as a result of suppurative inflammation. In about half the cases both testicles are injured. There is usually considerable shock and severe pain experienced at the time. Neuralgic pain, often severe enough to demand castration, is not an infrequent consequence. A gunshot injury of the testicle should be treated as conservatively as possible. Scrotal fistulæ usually heal after scraping with a sharp spoon and dusting the surface with iodoform.

As a matter of fact, gunshot injuries of Arteries and Veins comparatively rarely come under treatment. This infrequency of wounds of the arteries by gunshot injury is more apparent than real, as, almost without exception, a man wounded through one of the main arteries dies where and when he falls, before aid can reach him. Stromeyer estimated the number of vessel wounds at 3 per cent. of the total of those wounded. When the artery is fixed, especially if it be enclosed in a bony canal like the vertebral or middle meningeal arteries, it is more liable to injury.

The bullet may directly injure the vessel, cause a fragment of bone to be driven against or into it, or pass partially round the vessel, contusing and separating it from its vascular connections, especially in the thigh. This is liable to be followed by sloughing or ulceration. The fact of gunshot contusion is rather inferred from the clinical history of the cases and the frequency of secondary hæmorrhage than proved by post-mortem demonstration. The artery may be lacerated, and completely or partially divided by the bullet. The bullet or a fragment of bone may lodge in the vessel-wall itself, causing a temporary obliteration which is rarely definitive, but mostly followed by secondary hæmorrhage. When the projectile lodges in the vessel-wall it soon becomes displaced by its weight. This lodgment is not infrequent. It is a common experience for fearful hæmorrhage to follow attempts at extracting either a bullet or a fragment of bone, and in some cases it may be due to this circumstance.

In large vessels the bullet may traverse the vessel, and make an entrance and exit wound. The writer amputated a thigh for gangrene in Servia, in which a subsequent examination showed two well-defined circular apertures of this kind in the popliteal artery caused by the bullet traversing it. The same thing has occurred in the aorta, and the iliac and carotid arteries. In other cases the ball cuts out a portion from the side of the vessel. When a limb is carried away by artillery fire there is often no bleeding, the elasticity of the main vessels allows of their being drawn out of their sheath before giving way, and, in a manner analogous to that of torsion, their lumen will be closed by retraction of the inner and middle coats.

When a large vessel is wounded the hæmorrhage is usually directly fatal. If otherwise, spontaneous arrest may occur until the man is carried to the nearest field hospital. The provisional clot arrests the bleeding for a time. Severe bleeding is still less frequently observed from wounds of large veins. In gunshot wounds of the head the bleeding may be copious from one of the sinuses, and may be recognised by a rhythmical increase during expiration. In a few cases there has been an entire absence of bleeding at first, and after an interval a sudden hæmorrhage may take place. Probably the artery has been injured by a ball or fragment; the foreign body remains lodged and occludes the wound, and on its removal or separation by inflammatory processes, usually ten or twelve days after the injury, sudden bleeding occurs.

Secondary hæmorrhage frequently occurs about two or three weeks after the injury from separation of a contused portion of the artery, or an unhealthy suppuration in the wound causing ulceration of the arterial tunics. The increased action of the heart, due to fever, may dislodge the clot and give rise to hæmorrhage. Generally during the first week, or up to the tenth day, rough manipulation, difficult transport, cough, vomiting, straining at stool, may excite it. The same principles which are adopted for hæmorrhage occurring in civil practice are applicable to its occurrence after gunshot wound. In all cases of primary bleeding the wound in the vessel should be, if possible, exposed, and a ligature applied above and below the injured point. Where the position of the injury is such as to render it anatomically inaccessible, a ligature may be applied to the main trunk on the proximal side. *See* ARTERIES, Wounds of.

In secondary hæmorrhage the same rules apply; but the difficulty of finding and securing the bleeding points in the wound is greater. Nevertheless the attempt should always be made; where it fails we may tie the main artery in its continuity, but the results are most unsatisfactory. The circumstances which conduce to the frequent occurrence of secondary hæmorrhage continue, and it is apt to recur either in the original wound, or from that made in order to secure the artery about the time the ligature separates.

QUESTION OF OPERATION FOR GUNSHOT INJURY.—The majority of gunshot injuries in time of war take place in the extremities—three occurring in the upper to four in the lower. The gravity of the injury depends as a rule on the extent to which the bone is fractured or a joint involved. It is for cases such as these that the majority of amputations, either in continuity or through an articulation, require to be performed. It may be laid down as a rule that primary amputation of part or whole of the upper extremity is seldom if ever required for bullet wound, however extensively the bone may be fractured; even in cases where the brachial artery has been divided an attempt should be made to save the limb, although amputation may become necessary at a later period.

The injuries of the upper limb which may demand amputation are extensive lacerations of soft parts produced by shell-fragments. In civil practice it may be necessary from a charge of shot fired into the axilla, destroying the axillary vessels and nerves, or the structures in front of the elbow. In the case of injury to the joints, conservative treatment should always be first adopted. Primary excisions are more dangerous to life than those performed at a later period, and the results, as regards the function of the limb, much less satisfactory.

In the lower limb, other things being alike, the effects of gunshot injury are more severe than in the upper, and amputation more frequently called for. In the lower extremity, flesh wounds, except those produced by extensive shell-injury, or complicated by injury to the principal nerves or vessels, seldom demand amputation. Gunshot fracture of the femur is the most frequent form of fracture of the long bones, and the most dangerous to life, the mortality being, in wound of the upper third, 72 per cent.; middle third, 60 per cent.; lower third, 53 per cent. Formerly amputation was generally performed for this injury; but recent experience proves that expectant treatment affords the best results, especially when the wounded can be properly treated from the time of injury, and have not to be transported. Stromeyer has done much to establish this principle of treatment. After the battle of Langensalza, out of 38 cases of fracture of the femur, 28 recovered under conservative treatment; and the writer had an opportunity of seeing the cases under Stromeyer's care in the field hospital at Floing, close to Sedan, where 24 cases of fracture of the femur recovered out of 34—a per-centage of 70·6 per cent.

Fractures of the leg are not nearly such dangerous injuries as those of the thigh. When produced by shell-fragments the damage is often so extensive as to demand amputation, especially when in the neighbourhood of the knee. Bullet wounds often cause very extensive fissuring, which may involve either the knee or the ankle joints. In these, although primary amputation may not be deemed necessary, subsequent inflammatory changes may render it imperative at a later period; otherwise, expectant treatment yields, in general, better results than operative interference.

The mortality after amputation of the leg varies in an extreme degree in different campaigns. During the American war it was only 26·02 per cent.; in the English army in the Crimea 34·52 per cent., whilst among the French it reached 71·95 per cent.; among the Germans in the war of 1870–71 it was about 36 per cent., whilst among the French troops during the same campaign the deaths after amputation of the leg amounted to the frightful mortality of 82·34 per cent.

In injuries of the foot and ankle, conservative treatment is in the first instance to be adopted. If this fail, secondary excision of the ankle-joint may be performed —an operation which has attained, in Langenbeck's hands, the most brilliant results—or such portions of the foot only amputated as it may be impossible to preserve. The death-rate after amputation at the ankle-joint is not great. During the American war it amounted to 13 per cent. Gunshot injuries to the tarsus generally are not very dangerous, and often heal, as Stromeyer has pointed out, with unexpected facility after the extraction of the bullet. When, as the result of inflammatory processes, caries or necrosis of these bones is set up, the methods of treatment adopted will be identical with those employed for similar conditions occurring in civil practice.

The difference of opinion amongst the older surgeons as to the comparative merits of primary and secondary amputation has long since been settled in favour of the former.

As regards the place of amputation, only what is irretrievably damaged should be removed. The maxim 'Jeder Zoll, dem Leben naher!' should be borne in mind. Every inch removed adds to the patient's risk. It is, however, sometimes difficult to determine the degree of injury inflicted on the soft parts. In cases of severe contusion and laceration, the damage to the skin and muscles often extends further than is apparent, and after operation, gangrene of the flaps, necrosis of fascia, and suppuration in the intermuscular cellular tissue follow. Where the amputation is performed during the secondary period it is easy to determine the place of operation, and it is by no means necessary to discard the infiltrated and inflamed skin, or tissues through which fistulæ pass; they may often be used for covering the stump, all granulation tissue being previously scraped away, the surface disinfected, and good drainage provided for. At one time a limb was often amputated at a higher point than the injury rendered necessary in order the more readily to accommodate the stump to the instrument-maker's apparatus, a proceeding now properly abandoned. The instrument-maker should accommodate his apparatus to the stump just as much as a shoemaker fits his boot to the last.

This is not the proper opportunity to discuss the various methods of operation. Suffice it to remark that the flaps to cover the bone must be made much more ample than is needful in cases of disease. This is especially true of muscular flaps. The muscles are large and thick, and the skin retracts to a greater degree than in a limb the subject of disease; the operator is therefore not unlikely to underestimate the amount of covering required. As a rule, only a limited amount of muscle should be preserved in the flaps. In all cases where it is practicable, a circular or flap-shaped piece of periosteum should be detached from the bone to a sufficient extent to allow the cut end to be covered by it. The subsequent risks are thus diminished, the periosteum protects the medullary cavity, there is less chance of necrosis, and the stump subsequently is less sensitive and better able to sustain pressure. It is easy to separate the periosteum with an elevator, and it should be detached from the bone in such a manner as to retain its connection with the external soft parts. The more quietly and deliberately an operation is performed the better. Bleeding points should be secured as soon as possible with pressure-forceps. Too much pains, time, and attention cannot be bestowed on the task of thoroughly arresting the bleeding from every point. The occurrence of reactionary bleeding, necessitating as it does a change of dressing, diminishes considerably the chances of the patient's recovery. So far as they are practicable, strict antiseptic precautions should be adhered to throughout.

The rules laid down with regard to amputation are equally applicable to disarticulations. The operation is scarcely so favourable as amputation. It is more difficult to execute, and often involves a larger sacrifice of tissue, while artificial apparatus is more difficult to apply. For some of the joints the flaps are made of skin only, and in some, as at the knee, they are so long as to be extremely liable to gangrene; in others, as at the hip, muscle is usually included.

The mortality after amputation has very much diminished during recent wars; there are, however, no considerable statistics giving the results of operations performed with antiseptic precautions, and the tables of mortality hitherto recorded can only afford us the comparative rate of death after operations in different regions. Fischer has added together the results of the Crimean, Italian, American, Schleswig-Holstein, and Franco-German wars. He finds the mortality after amputation of the thigh is 82·6 per cent.; of the leg, 61·3; of the foot, 46·7; of the arm, 37·4; of the forearm, 21·2.

The comparative mortality of disarticulation arrived at in a similar manner is, after the disarticulation at the knee, 68 per cent.; at the shoulder, 62·8; at the elbow, 24·0; at the wrist, 42·2. Disarticulation at the hip-joint gives a mortality for primary operations of 91·6 per cent.; intermediate, 95·2; secondary, 76·6.

The antiseptic method of treatment will change all these figures. Schede gives tables of 321 cases of amputation treated antiseptically, in which only 14, or 4·4 per cent., died. 86 of these cases were amputations of the thigh, with 6 deaths, or 6·9 per cent. 69 amputations of the leg, with 1 death, 1·4 per cent. Amongst the 14 deaths, there were only 2 cases of pyæmia. Of 387 cases of amputation of equal importance, treated according to the old plan, 110, or 29·18 per cent., died, and there were 98 cases of pyæmia. Schede further calculates that, if the cases of pyæmia be omitted, the number and causes of death were almost identical in the two series.

The chief causes of death shortly after the operation are shock, hæmorrhage, and exhaustion; those occurring later are almost always from septic poisoning. It has been observed in recent wars, by the majority of surgeons, that pyæmia becomes much more frequent during the later periods of the war than at the beginning.

The operation of excision of joints is more generally applicable and followed by better results in the upper than in the lower limb. As regards the function of the limb afterwards, secondary resection is better for the function of the part than primary. This is especially true of the shoulder, elbow and ankle. The mortality is, however, higher. According to the returns in Circular VI., the results ascertained in these cases were as follows:—

	Deaths	Mortality
Of 210 primary resections . .	50 .	23·8 p.c.
Of 298 secondary ditto . . .	115 .	38·8 „

When the **Shoulder-joint** is largely opened into, and the head of the bone or glenoid cavity fractured, excision may be performed, and the same rule holds good in the elbow and wrist. The best method of operation is by means of a straight incision in front of the shoulder-joint, and at the back of the elbow and wrist joints. The periosteal investment of the bone, together with the muscular attachments, should be scrupulously preserved. It materially diminishes the amount of bleeding at the time, and enhances the power of joint-movement afterwards.

Esmarch has published the results of 40 cases of excision of the **Elbow**; 6 only died, while 32 recovered with a more or less useful arm. One of the two remaining cases was amputated; the other never healed.

In 285 cases of excision of the elbow recorded in the American reports, the mortality amounted to 21·67 per cent. According to Billroth, the mortality after excision of the shoulder is 35 per cent., whilst among the injuries of that joint treated conservatively the mortality was 52 per cent.

The after-treatment of cases of excision in the upper limb should be simple. Stromeyer's cushion is the best apparatus for shoulder and elbow excisions, and as free movement is the result sought for, passive motion should be resorted to as early as possible.

Gunshot injuries of the **Hip-joint** have been regarded as very hopeless cases. Great doubt must exist in many cases as to the exact extent of the injury; the parts are very inaccessible, the symptoms uncertain, and a precise diagnosis often impossible. Out of 385 cases observed during the American war in which gunshot fracture was believed to have involved the joint-surfaces, 304 were treated expectantly, in 55 excision of the hip-joint was performed, and in 27 the limb was disarticulated. In the 304 cases the mortality was 81·9 per cent. Of 33 cases involving the acetabulum and head of the femur, only one recovered. The other cases of recovery were fractures in the neighbourhood of the joint, in a few of which it was undoubtedly involved.

Langenbeck has recorded 25 cases of injury of the hip followed by recovery during the war of 1870–71. It would be for the interest of surgical science that the precise extent of the injury to the joint in these cases should be ascertained by post-mortem examination.

During the American war the mortality after excision of the hip-joint was 90·6 per cent. In a total of 171 cases of excision collected from various sources, the death rate was 86·5, the mortality following the operation being somewhat less during later wars. Both after excision and amputation the mortality is greatest among those cases operated on during the intermediate period. It is least during the secondary period, when it closely approaches that for similar operations performed for disease in adults of the same age. Nevertheless, the disastrous results following gunshot fracture involving the hip-joint will prompt the surgeon to perform primary excision, rather than to expose his patient to the enormous risks of the inflammatory period; the fact that 23 survived out of 171 cases of excision, 1 being amputated and 22 possessing a more or less useful limb, is an encouraging result in a very hopeless class of cases.

In 250 cases of amputation at the hip-joint for gunshot injury, collected from different sources, 27 recovered, the mortality being nearly 90·0 per cent.

Of 27 primary amputations, 3 recovered. Of 23 intermediate amputations, all died. Of 9 secondary amputations, 2 recovered. The operation had therefore better be performed at once, unless it can be more safely delayed until the secondary period.

Secondary excision is demanded in cases of caries or necrosis, or secondary implication of the joint-surfaces.

Disarticulation at the hip-joint should be performed when the thigh is torn off; the upper extremity of the femur comminuted, with great laceration of the soft parts too high for amputation in continuity; for fractures of head, neck, or trochanters, complicated with wounds of the femoral vessels; for fracture involving the hip-joint, complicated with compound fracture lower down, or wound of the knee or ankle joints.

Knee-joint.—During the American war the opinion was generally in favour of immediate amputation for gunshot injury of the knee, and with few exceptions this also was the opinion of all former writers; in about one-fourth of the cases expectant treatment was adopted, with an attendant mortality of 60·6 per cent. The cases reserved for expectant treatment were the most favourable ones, and in 117 of the cases which recovered the patella only was fractured, and the synovial cavity not opened in the first instance. The result, nevertheless, contrasts unfavourably with the mortality after amputation of the thigh for gunshot fracture of the knee, which was only 51·1 per cent.

In a certain number of the cases the capsule only was injured, or only trifling damages inflicted upon the bone. In these the mortality was only 27 per cent., and such cases should when diagnosed be treated conservatively. Bergmann reports 21 cases without bony lesion during the Russo-Turkish war; 18 recovered, in 3 the result was unknown, and in 31 cases involving the bone 20 recovered and only 1 died. Langenbeck believes recovery to be much more common than is generally supposed in gunshot fractures of the knee-joint.

Primary excision of the knee is an operation which is scarcely justifiable in military practice, the mortality being 86·6, far in excess of amputation of the thigh, and the experience of later wars shows a similar excessive mortality. With our present knowledge we must pronounce an emphatic opinion against it. Amputation through the knee-joint itself is a little more unfavourable as regards mortality than amputation of the thigh. In 10 per cent. of the cases, re-amputation was found to be necessary. The stump, however, after recovery is a very good one.

Ankle-joint.—During the American war the general opinion seems to have been in favour of amputation for gunshot fracture involving the ankle-joint. In 159 cases of amputation of the ankle-joint itself the results were ascertained, the mortality being 25·1 per cent., or 7·8 less than the death rate after amputation of the leg. These operations include Syme's and Pirogoff's amputations, with their modifications.

Excision of the ankle seems to be rather more dangerous than amputation; the operation was seldom complete. The primary operation was the more favourable as regards life. Langenbeck is in favour of secondary excision on account of the more complete restoration of the portions of bone removed. The mortality after excision varies in different estimates from 29 to 33 per cent. Among cases treated expectantly, the mortality appears to have been 20 per cent. Where amputation is required it will generally have to be performed in the leg. The mortality after primary amputation is 5·3 per cent.

It is hardly necessary to go into details with regard to partial amputations of the foot. Individual bones may often require to be excised in addition to the performance of the more recognised operations.

William MacCormac.

GUSTATORY NERVE, Division of; Stretching of.—Division of the gustatory nerve for the relief of pain, caused by cancer of the tongue, was practised by Hilton and, subsequently, by Charles H. Moore. By Moore's operation—in most cases preferable—the nerve is cut a little in front of the point at which it emerges from between the ramus of the lower jaw and the internal pterygoid muscle, to cross obliquely to the side of the tongue. At this point it lies near and just below a ridge, which can be felt by the fore-finger, on the inner aspect of the lower jaw.

The point of a curved bistoury is introduced well through the mucous membrane of the floor of the mouth, at about the level of the last molar tooth, internal to the course of the nerve, and then made to cut out to the lower jaw and upwards, along its inner surface, in a direction corresponding with a line from the angle to the last molar tooth.

The relief may be considerable, at all events until the ends of the nerve have again united; but, unfortunately, the cases in which this operation is most likely to be required are those in which, from infiltration by cancer, the tongue is so fixed, and the landmarks are so obscured, that it becomes difficult to ensure division of the nerve excepting by incisions, which are by no means free from trouble in respect of hæmorrhage. Chloroform, also, may be necessary, and, in that case, the guide as to the division of the nerve, given by the patient's sensations, will be lost. On these accounts the operation is not now very frequently performed. In many cases, too, relief can be given in other ways. See *Palliative Treatment* under TONGUE, Diseases of the.

The gustatory nerve has been divided for the relief of obstinate neuralgia. Its division, in such a case, presents no difficulty. The nerve has also been *stretched* for the relief of the same complaint. Clement Lucas observed, in a case under his care, that on pulling the tongue strongly forward and to the opposite side, the nerve stood out as a cord beneath the mucous membrane, and could be readily fixed by passing a small, sharp hook around it. On dividing the mucous membrane, the nerve was then easily caught up by an aneurism needle. The same operation may be performed when it is desired to excise a portion of the nerve; or the latter may be dissected out at about the level of the last molar, through a vertical incision extending through the mucous membrane and margin of the sublingual gland (Hilton's method).

W. MORRANT BAKER.

H

HÆMATOCELE. — Any effusion of blood into the tunica vaginalis, testicle, or spermatic cord is called a hæmatocele. We must speak separately therefore of (A) *Hæmatocele of the Tunica Vaginalis*; (B) *Hæmatocele of the Spermatic Cord*; and (C) *Hæmatocele of the Testicle*.

(A) HÆMATOCELE OF THE TUNICA VAGINALIS.—1. *Causes.*—These may be classified as predisposing and exciting. The predisposing causes are, atheroma of vessels, leading to their brittleness and loss of due elasticity, by which they are rendered liable to rupture from sudden increase of internal pressure; chronic inflammation of the tunica vaginalis with the formation of vascular granulation-tissue on the inner surface of the serous sac, and very delicate vessels easily ruptured; and hydrocele. The second of these causes is laid stress upon by Gosselin; but other authorities consider the appearances on which he relies for evidence in support of his view, as really secondary to the effusion of blood. Hydrocele is of extreme importance, as predisposing to hæmatocele; for not only does it very commonly necessitate an operation for its relief, during which some vessel may be punctured, but the distension of the tunica vaginalis renders the scrotum far more liable to contusions than it is in its normal condition. Owing to the testicle being immovable in the scrotum, all violence applied to this part acts upon the testicle, which is frequently ruptured by squeezes and blows that would be harmless in the normal state. The exciting causes of hæmatocele are strains rupturing vessels into the tunica vaginalis, blows and punctures. When a hydrocele is tapped, the mere removal of the pressure to which the vessels of the serous membrane have become habituated may lead them to rupture; or the lancet or trocar may wound a parietal vessel, or be thrust into the cord or testis. This is more liable to happen when a lancet is used than with a trocar, and this fact is a sufficient reason for preferring a trocar to a lancet in cases where the tunica vaginalis requires puncture. Strains and blows of moderate severity are causes of hæmatocele probably only when the natural resistance of the vessels is diminished by previous disease.

2. *Pathology.* — The tunica vaginalis may contain a mixture of serous fluid and blood in various proportions, in which coagula of blood are sometimes found floating; at other times the blood is altered and becomes converted into a dark fluid of syrupy consistence, resembling treacle in appearance, or, becoming still thicker, it looks more

like coffee-grounds, and contains cholesterine. When the sac contains pure blood, this may coagulate into a spongy mass, which may present quite a honeycombed appearance, being riddled with spaces containing serum. In other cases the fibrin separates from the blood in dense layers, like those usually found lining the sac of an aneurism, and a certain amount of dark blood-clot may be found in places between the concentric laminæ of fibrin, or filling up a central cavity. The tunica vaginalis itself is thickened by a deposit of vascular 'false membrane' on its inner surface; this is generally considered to be secondary to the effusion of blood, but Gosselin argues that it is really primary, and that the hæmatocele is due to the rupture of delicate vessels in this membrane. The testicle is generally found in the lower and posterior part of the sac; but in cases of inversion of this organ, it will be found in front. It may be unaltered in outline and structure, but usually it is flattened out by the pressure of the effusion, and in cases of long-standing hæmatocele the testicle may be greatly wasted. Occasionally the occurrence of hæmatocele is followed by inflammation and suppuration of the scrotal coverings, and the sac of the tunica vaginalis is then found to contain a mixture of pus, fibrinous coagula, and blood-clot. In very chronic cases, the sac may become calcified.

3. *Symptoms and Diagnosis.*—The sign of most constancy and value in the diagnosis is the rapid development of an opaque scrotal tumour after a strain or local injury, or the sudden enlargement of a hydrocele with loss of its former translucency. The tumour is limited to the scrotum, is ovoid in shape, sometimes becoming globular, smooth in outline, always opaque throughout, and often fluctuating; but this varies greatly in different cases or in the same case at different times, for when the blood coagulates, the tumour, like other solid tumours, is devoid of fluctuation. There is at the time of its early formation an absence of signs of acute inflammation, but these may develop later on; the skin may quickly become mottled or deeply stained with blood. If the finger be pressed into the tumour at different places, 'testicular sensation' may be excited at one particular part of the tumour, and indicate the position of the testicle. The cord above the tumour is not enlarged, and there is no swelling of the iliac or lumbar glands. It is usually stated that a hæmatocele is a heavy tumour; but it is very doubtful if this is of any value for diagnosis, and if, indeed, it is possible to detect the difference in weight of hæmatocele, hydrocele, and sarcocele. If a rapid effusion of blood occur, the patient may experience symptoms of syncope at the time. The tumour may remain stationary as a fluctuating swelling; or it may solidify and contract; or the parts may become inflamed, the swelling increasing, the skin becoming hot, bright red, and tender, and at length an abscess points and bursts, discharging pus mixed with 'coffee-grounds' material, or masses of laminated fibrin. The diagnosis largely rests upon the history of the first formation of the tumour—its suddenness or marked rapidity without signs of inflammation, and its connection with strain, a blow, or the tapping of a hydrocele. In some old cases of hæmatocele it is impossible to make a certain diagnosis from tumour of the testicle without exploratory puncture (where the tumour is fluid), or incision (where the tumour is solid); but the absence of persistent growth, enlargement of the cord, and glandular implication, and the detection of the testicle at one particular part of the swelling, are the signs on which reliance is to be placed. An exploratory puncture may evacuate treacly fluid or 'coffee-grounds' material, and lead to the partial or total collapse of the swelling; exploratory incision, where the tumour is solid, will show thick masses of laminated fibrin or spongy blood-clot. *See* Testis, Diseases of the.

4. *Treatment.*—If seen immediately, the patient should be put to bed, and the scrotum be raised on a pillow placed between the thighs, and a light bag of crushed ice and salt applied. The bowels should be freely opened with a dose of calomel, followed by a saline draught; the diet should be light and unstimulating, and at the same time the patient should lie as still and quiet as possible. This may succeed in leading to the absorption of the blood. Should absorption not occur, and the blood continue fluid, the tumour should be tapped in the same way as a vaginal hydrocele, care being taken not to injure the testicle, and if after the blood is withdrawn much thickening remain behind, the part should be firmly strapped—this will accelerate the absorption of the fibrin and blood-clot. If the tumour be wholly or largely solid, a free incision should be made into it. This should be done carefully and gradually, as it may be impossible in these cases to localise precisely the testicle, and the surgeon should therefore cut slowly down, examining each

section before deepening it; the softer central parts may be easily evacuated, and then the firmer outer layers should be stripped off the tunica vaginalis, and the wound plugged and allowed to granulate up from the bottom; or if the surgeon prefer it, he may place a drainage-tube in the cavity, and stitch up his skin-incision. Where the tumour is of very long standing, and the fibrinous masses are so adherent to the thickened sac that they cannot be detached from it, the whole mass—testicle and all—should be excised. Where, too, the surgeon is so unfortunate as to inflict an extensive wound upon the testicle, castration should be performed. When inflammation occurs, the patient should be put to bed and the scrotum be treated with hot belladonna fomentations; or equal parts of extract of belladonna and glycerine may be smeared thickly over the part, and plain hot fomentations applied over it. When suppuration is suspected or has evidently occurred, a free incision should be made into the tumour, all the pus and clots turned out, and the cavity allowed to granulate up from the bottom.

(B) Hæmatocele of the Spermatic Cord.—1. *Causes.*—This may result from direct injury—blows and the like—or from strain, and it may be predisposed to by the presence of an encysted hydrocele of the cord.

2. *Pathology.*—The blood may infiltrate the cellular tissue of the cord and its coverings, or it may be effused into the sac of a hydrocele, or, being small in quantity, may become circumscribed in the cord. In the first case the tumour may attain an enormous size, and is known as a diffused hæmatocele of the cord; in the two latter instances the tumour is small, and is known as encysted hæmatocele of the cord.

3. *Signs and Diagnosis.*—Hæmatocele of the cord is a very rare affection. When diffused it may attain an enormous size, forming an elongated tumour, which may overlap the thigh for many inches; the tumour is boggy to the touch, dull on percussion, and the skin over it is freely movable. When encysted, the tumour is much smaller, tense, globular or ovoid in shape, opaque, with more or less distinct fluctuation, and fixed to the cord. Such a tumour may have been preceded by a smaller, translucent tumour. In either case the tumour will have followed more or less immediately upon a strain or blow on the part.

4. *Treatment.*—A diffused hæmatocele, when recent, should be treated by rest, and the local application of cold, aided by a free purge and low diet. When this proves ineffectual, or the case comes for treatment at a later stage, absorption of the blood may be aided by counter-irritation by means of fly-blisters to the part, or painting it with tincture of iodine night and morning. Should these measures fail after a fair trial, and the tumour be of distinct inconvenience to the patient, the surgeon should make a free incision into it for its whole length, let any blood that will, escape, and then plug the wound and allow it to granulate up. Encysted hydrocele in the acute stage may be treated like the diffused; if absorption do not occur and the blood remain fluid, it may be tapped with a trocar; and should this fail to effect a cure or the tumour be found to be solid, it should be freely incised and the entire sac dissected carefully out from the cord; or the surgeon may content himself with turning out all the contents of the cyst and plugging the wound.

(C) Hæmatocele of the Testicle consists of two distinct affections: hæmorrhage into an encysted hydrocele—encysted hæmatocele of the testicle; and hæmorrhage into the substance of the gland itself—parenchymatous hæmatocele. Both are rare, the latter especially.

Encysted Hæmatocele of the Testicle.—1. *Causes.*—This condition only occurs secondarily to an encysted hydrocele of the testicle, the effusion of blood being due to injury, such as a blow or squeeze rupturing a vessel in the cyst-wall. Tapping such a cyst may be followed by hæmorrhage, as in the case of vaginal hydrocele.

2. *Pathology.*—The pathology is exactly similar to that of vaginal hæmatocele. *See* also *Encysted Hydrocele*, under Hydrocele.

3. *Symptoms and Diagnosis.*—In its position and general characters the tumour resembles an encysted hydrocele, being tense, globular, and adherent to the testicle or epididymis. It differs, however, in being opaque; the fluctuation in it is less distinct, and there may be marked tenderness. The diagnosis is further aided by the fact that the swelling, which is of a chronic nature, has rapidly or suddenly increased after a squeeze or some similar injury to the parts, or that the swelling has rapidly re-formed after tapping a hydrocele.

4. *Treatment.*—In the acute stage, rest and cold applications are indicated. Later on the cyst may be tapped and injected with iodine, or freely incised, evacuated, and dressed from the bottom; where the blood has coagulated but is not absorbed, the latter is the only appropriate treatment.

Parenchymatous hæmatocele is an effusion of blood inside the tunica albuginea. It is always the direct result of a severe injury to the testicle, and is a cause of acute pain. The blood is poured out from the layer of fine vessels beneath the tunica albuginea called the tunica vasculosa. This condition is probably in all cases associated with vaginal hæmatocele, which obscures the enlargement of the testicle. The blood may be absorbed, or may remain as a firm or friable mass, or may lead to the softening of the tunica albuginea and its ultimate rupture. The tubular structure of the testicle is compressed, and the organ probably never regains its former size or functional activity.

1. *Symptoms and Diagnosis.* — When, combined with the signs of vaginal hæmatocele, there is severe and persistent pain in the testicle, extending up along the groin to the loin, and the testicle is found very sensitive to pressure, a parenchymatous hæmatocele may be suspected. When, on tapping, or otherwise evacuating the vaginal sac, the testicle is found to be enlarged and tender, this diagnosis becomes assured. If the scrotum is freely incised, the wound does not heal and the enlarged testicle presents, and a dark or livid protrusion from its surface may be recognised; in some cases fluctuation may be detected in this projection.

2. *Treatment.*—When there is reason to suspect this condition, great care should be taken to ensure absorption of the effused blood by rest, cold applications, purgatives, and suitable diet. Should the vaginal hæmatocele be absorbed or yield to simple tapping, the enlarged testicle should be carefully strapped. If the scrotum is incised, and the position of the parenchymatous hæmatocele can be verified by fluctuation, livid colour, or obvious protrusion, a free incision should be made into it and the blood be turned out. Great care should be taken to render such a wound aseptic.

A. Pearce Gould.

HÆMATOMA. *See* Bruises; Head-injuries; Scalp, Injuries and Diseases.

HÆMATOMA AURIS. *See* Ear, External, Diseases of the.

HÆMATURIA. — *Definition.*—Blood derived from any part of the urinary system —be it from its secreting, conducting, or collecting divisions—and passed pure, or mixed with urine, constitutes the symptom known as hæmaturia. It will be observed that the above definition is so framed as to include urethral hæmorrhage, which is always admitted for convenience' sake under this heading, though not strictly speaking hæmaturia. Hæmaturia is a symptom which may occur, not only in the course of most of the diseases and injuries to which the tract is liable, but also in some morbid conditions of the blood, e.g. purpura, scurvy, smallpox, typhoid, &c., and in some cases of metallic poisoning, e.g. mercury, lead, arsenic. The colour of the urine may vary through many shades, from a cherry red (1 in 800, Ralfe), to a maroon colour, or from a smoky or beef-tea aspect to a porter-black, according to the proportionate admixture of the two fluids, and the extent to which the methæmoglobin, or the oxyhæmoglobin has been altered by the action of the urine.

Fallacies.—These colours may be simulated by the effect upon the urine of particular drugs or certain articles of diet— e.g. senna and rhubarb give a reddish tinge to alkaline urine; carbolic and salicylic acid impart a brownish colour, while beetroot, sorrel, and prickly pear produce a blood-red aspect. Again the urine in certain pathological conditions—e.g. in severe jaundice, melanosis, and splenic fever—assumes a deep brown colour, while in the female the mere admixture of menstrual discharge may deceive by its colour a careless or superficial observer.

Tests.—The following are reliable:—

Microscopical. — Blood-corpuscles are seen more or less altered by the action of the urine. *Fallacies.*—In hæmatinuria they are absent, and in very alkaline urines they are only detected with difficulty.

Spectroscopical.—Blood, even in minute quantities, will give two absorption-bands between the Frauenhofer lines D and E in the yellow and green of the spectrum.

Chemical (*a*). The formation of Teichmann's crystals on heating traces of blood with glacial acetic acid and a crystal of salt; (*b*) invariable presence of albumen; (*c*) a particoloured fluid being left after the settling of the brick-red precipitate produced by boiling the urine with caustic soda.

It is imperative to ascertain the site and cause of the hæmorrhage. We may divide these sources into three groups: (*a*) renal, including the pelvis of kidney and ureter; (*b*) vesical, including the prostate; (*c*) urethral.

Differential diagnosis of source of blood.—1. *Colour*, in bright florid urine it is probably of vesical, in dark or smoky urine of renal origin. *Fallacies.*—If from any cause the blood has been retained in the bladder, it will assume a dark colour in proportion to the action of the urine upon it; indeed, sometimes, if long pent up in that viscus, it may be evacuated like tar or molasses. Again, if the blood issues in large quantities from the pelvis, rapidly traverses the ureter, suddenly distends and thereby stimulates the bladder, it will be expelled thence, bright, fluid, and unchanged.

2. *Reaction.*—Bloody urine, if acid, is generally of renal source; if alkaline, of vesical origin. *Fallacies.*—(*a*) ingestion of alkalies (inducing alkalinity of urine); (*b*) a profuse effusion of blood, or (*c*) an excessive production of pus, may mask, by their alkalinity, the natural acidity of the renal secretion. In these cases the hæmorrhage may be from the kidney, although the reaction would point to vesical mischief.

3. *Aspect of clots.*—By floating the coagula in water, they may so unravel as to afford us a clue to the seat of the hæmorrhage. The softer, the brighter, the plumper the clot, the fresher is the effusion and the nearer is the site of the hæmorrhage to the outlet. The more decolorised and eroded the clot, the longer has been its retention in the tract. Slender cylindrical worm-like clots are generally moulds of the ureter; thus they localise bleeding in or above that canal. Large, irregular, shapeless, edge-eroded clots are usually of vesical origin. Leech-like, ovoid clots are from the posterior portion of the urethra, and long bougie-like coagula are from its anterior part. *Fallacy.*—The blood may have been of renal origin, or have regurgitated from the urethra and become moulded in the bladder; thus renal or urethral hæmorrhage may simulate vesical.

4. *Aspect of urine on micturition.*—If the blood issues independently of micturition, or if it is evacuated first and then followed by clear urine, the source is urethral. If the urine is at first clear, or only tinged with blood, becoming darker, or even like pure blood, at the close of the act, it is vesical. If uniformly mixed, it is, most likely, renal. *Fallacy.*—Blood issuing from the bladder-wall, or regurgitating from the urethra, may become so intimately mixed with the urine there collected—especially if the quantity of the blood be small—as markedly to simulate renal hæmaturia.

5. *Microscopical.*— Blood-casts are conclusive proofs that the secreting substance of the kidney is involved. Triple-phosphate crystals in freshly passed urine are tokens of vesical mischief.

6. *Instrumental.*—Wash out the bladder very gently, three or four times, and notice the colour of the washings; now insert a gum-elastic or flexible catheter just within the thus emptied bladder; the urine will trickle directly from the ureters into the eye of the instrument (Sir H. Thompson). Compare carefully the samples thus obtained.

7. *Symptoms.*—Certain symptoms referable to source are usually obtainable. Heat, tenderness, aching or pain in one or both loins, numbness of leg, retraction of testicle (in stone, not carcinoma) would point to renal origin; supra-pubic, perineal, or penile pain, dragging weight in perineum, dysuria would indicate a vesical source, or at least implication of that viscus.

Pathology and Etiology.—Any active or passive hyperæmia, any inflammation or ulceration, any vascular rupture in any section of the urinary tract, may give rise to hæmaturia. *Renal:* active hyperæmia (cantharides or turpentine), passive hyperæmia (thrombus of renal or inferior caval veins), embolism, renal diseases, traumatism, stone, neoplasms, calculous or tubercular pyelitis, transit of ureter by a stone. *Vesical:* traumatism, inflammation, ulceration, or enlargement of prostate; sudden evacuation of a chronically distended bladder; stone or foreign body, neoplasms, cystitis, varix vesicæ, ulcerations (tubercular, diphtheritic), parasites, (Bilharzia hæmatobia). *Urethral:* traumatism, stricture, impacted stone, acute gonorrhœa, chancre, neoplasms.

Diagnosis of cause.—The history and age of the patient are to be considered, all subjective and objective phenomena carefully weighed, and thorough examination of the abdomen and urine undertaken; but space will only permit us to point out that abdominal palpation may reveal a renal tumour, supra-pubic and rectal examination may disclose an infiltration or growth of the bladder, maybe an enlargement, or a deposit or growth in the prostate. The sound may detect a stone, or, by a sense of resistance, a vesical growth. The catheter may withdraw in its eye a shred of growth or disintegrating villus. Again, the microscope may confirm our suspicions of malignancy, aroused by the passing of small semi-gelatinous masses; or it may give us a clue to the calculous diathesis or formation, by the aspect of the crystals found in the urine; or it may demonstrate the bacillus tuberculosus in the small whitish clumps passed in pyuria mixed with blood, when these are stained with Ehrlich's solution; or, lastly, it may reveal the ova of the Bilharzia.

The hæmorrhage may be profuse in

traumatism, stone, or neoplasms. It is generally slight in active or passive renal hyperæmia, in embolism, in inflammation or superficial ulceration of the tract. Dark, porter-like urine, passed without pain or any other symptom, is most probably renal. Hæmorrhage in vesical carcinoma is generally sudden, profuse, and irregular in its occurrence; in villous disease it is slight but persistent.

In non-malignant vesical growths the hæmorrhage occurs suddenly, and usually precedes the pain and dysuria. In malignant disease this is generally reversed.

Prognosis.—If the hæmorrhage occurs in the course of febrile disease, it is unfavourable; without reference to the cause it may be said to depend upon the suddenness of the onset, the amount lost, the capability of bearing that loss, and the age and sex of the patient. The dangers which may arise from the *clot* are (*a*) absolute retention, (*b*) pyelo-nephritis from its decomposition, and (*c*) the formation of a stone upon it as a nucleus, all of which are luckily rare.

Treatment.—Enforce, if possible, (1) absolute rest in the recumbent posture; (2) efficient application of cold. If renal, Leiter's tubes moulded to the loin; or, failing this, ice-bags or cold wet wraps to the same part. If vesical, Leiter's tubes or ice-bags adjusted to the supra-pubic and perineal regions. Ice in the rectum; ice-cold vesical and rectal injections. If urethral, pass a full-sized sound and gently apply a finger-bandage to the penis; apply ice-bag to the perineum.

Internal hæmostatics: Ext. ergotæ liq. fʒss.; Acid sclerotici (hypodermically), gr. $\frac{1}{4}$ to gr. j.; Liq. ferri perchlor. ♏x. to fʒss.; Liq. ferri pernitratis ♏x. to fʒss.; Acidi gallici gr. x.; Acidi tannici gr. x.; Infusi matico, f℥ij. Tr. Hamamelis Virgin. fʒss.; Plumbi acetat. gr. iij.; Ol. terebinth. ♏v. in passive hæmorrhages, administered cautiously.

Opium is of great value in every case, except it be in renal disease.

The following injections in vesical hæmaturia are of value: Alum gr. xx. to the pint; Nitrate of silver gr. j. to gr. iij. in f℥viij.; Liq. ferri perchlor. ♏xx. to ♏lx. in f℥viij.; Tr. Hamamelis Virgin. f℥j. ad f℥iv. Should the bladder become distended with coagula, it will be felt above the pubes as a hard round mass. Opium must be given freely to allay the dysuria, and the clot allowed to come away by itself.

If, however, absolute retention ensues, which is rare, or if enlarged prostate or atony of the bladder co-exist, a soft rubber catheter must be introduced, and a lithotrity evacuator adapted to it; thus the coagula can be carefully, slowly, and safely withdrawn.

E. Hurry Fenwick.

HÆMOPHILIA.—A hæmorrhagic diathesis, which is usually inherited, and in nearly all cases manifests itself during the first few years of life. Painful swellings of the joints are frequently associated with the disorder.

Cause.—Hæmophilia seems to be more common among the inhabitants of northern countries, but probably occurs in all parts of the world. Heredity is the only undoubted etiological factor, though gout, scrofula, tuberculosis, frights received by the mother during pregnancy, and consanguinity of parents, have all had a certain influence ascribed to them.

The hereditary transmission of the disease is usually characterised by a peculiar and definite order. For whereas the male sex is specially prone to hæmophilia, the disease is handed down through the females. In a typical case the children of a bleeder remain free from the disease, but hæmophilia reappears in the daughter's sons; these, again, beget healthy children, and transmit the disorder through their daughters to their grandsons. The daughters of a bleeder may also pass on the hæmorrhagic tendency, through their own daughters, to the sons of the latter. In none of these cases, as a rule, are the females themselves bleeders. The healthy brothers of a bleeder appear not to transmit the disease to their descendants. In rare cases the children inherit the tendency directly from their father or mother. More rarely still the females in a bleeder family manifest a greater proclivity to hæmophilia than the males. Bleeders are extremely prolific, but the proportion of the members of a given family that manifest the disease varies considerably. In some instances, hæmophilia seems to arise *de novo*.

Pathology.—No constant morbid changes have yet been detected in any part of the body. The blood shows no alteration whatever, and coagulates naturally until repeated hæmorrhages beget a condition of hydræmia, similar to that produced by any profuse bleeding. Coagulation then becomes defective. Changes have been found in different parts of the vascular system, but with no constancy. It is probable, nevertheless, that there is some subtle change in the small vessels. In certain cases there seems to be a state of plethora. A more intimate knowledge of the chemistry of the blood may possibly enable us to detect some error in its composition. The pathology of hæmophilia is still obscure.

Symptoms and Diagnosis.—Bleeders present no characteristic appearance whatever. Profuse and repeated hæmorrhage is the only positive symptom of the disease. The bleedings may take place from some free surface or cavity of the body, or they may be interstitial. They may be divided into two varieties, spontaneous and traumatic, which are often combined in the same subject. The spontaneous bleedings usually arise from some mucous membrane, less frequently they occur beneath the skin. In the traumatic form, the blood may come from almost any part of the body. The traumatic type is almost confined to the male sex. Both sexes, however, are liable to the spontaneous form of hæmophilia, which commonly takes the shape of epistaxis, or profuse menstruation in women. In fully half the cases recorded, hæmophilia declared itself during the first year, and in seventy per cent. the bleedings began before the end of the second year. The disease rarely makes its appearance later than the tenth year, and in no instance has it developed after the age of twenty-two.

As a rule the child is born without suffering any loss of blood, and division of the umbilical cord rarely causes serious hæmorrhage. Separation of the stump of the cord has occasionally been followed by considerable bleeding. More often the child seems healthy for some weeks or months after birth, until it is suddenly attacked by profuse hæmorrhage. This frequently takes place at the period of the first dentition, when the child begins to crawl about and is liable to slight injuries. In most cases the first bleeding is traumatic, though a tendency to spontaneous hæmorrhages usually develops subsequently. A tendency to traumatic hæmorrhage is found in the most marked cases, but is often characterised by great fluctuations in intensity. At times, the slightest injury is sufficient to cause alarming loss of blood. Similar or even graver accidents may lead to comparatively trifling hæmorrhage on other occasions.

Analogous variations in the tendency to spontaneous bleedings are also observed. Some bleeders recover rapidly from the effects of severe hæmorrhage, while others become profoundly anæmic and succumb, at last, to repeated losses of blood. Most of the well-marked cases of hæmophilia terminate fatally after frequent hæmorrhages. In some cases the hæmorrhagic tendency gradually declines with advancing years, and in one or two instances has suddenly and completely disappeared. If the period of puberty be safely passed, there is a fair chance that the patient may outgrow the disease.

The attacks of bleeding are sometimes preceded by symptoms of congestion of a more or less definite nature. Generally they come on without any warning, often in the night. Except when a large artery is injured, the blood oozes continuously from the affected part, and probably comes from the capillaries. The mucous membrane of the nose is the most frequent source of the bleeding. Next in order comes the cavity of the mouth and the gastro-intestinal canal. Subcutaneous hæmorrhages are not infrequent, and usually appear as irregular ecchymoses; at times they give rise to large fluctuating blood-tumours. The blood, in such extravasations, has a tendency to remain fluid for a long time. The skin of the extremities is the part most frequently affected. The uro-genital and respiratory tracts are less often the seat of bleeding. Cerebral and meningeal hæmorrhages are very rare. Extraction of a tooth is one of the most dangerous and fatal of all injuries, as the bleeding in such cases sometimes resists all treatment. Friction of a jagged tooth against the cheek or tongue, and the slightest abrasion of the gums, such as that caused by a toothbrush, have produced alarming results. Division of the frænum linguæ, circumcision, and blood-letting are also fraught with great danger. It is remarkable that serious bleeding is hardly ever caused by vaccination.

The peculiar joint-affection of hæmophilia, long considered to be rheumatic, has now been proved in some cases to be due to hæmorrhage into the joint, and this would seem to be its usual cause. It is probable, however, that some of the swellings are purely inflammatory. The affection consists in painful effusion into the joint, combined, at times, with ecchymoses of the skin. Any of the larger joints may be attacked, but especially the knee. The swellings are very apt to recur, and may lead to permanent enlargement or destruction of the joint, or to anchylosis. As a rule the swelling occurs spontaneously, especially in cold, damp weather, and is only exceptionally the result of an injury. The joint-affection is almost confined to the severe traumatic form of hæmophilia, and is rarely seen except in the male sex. Pains in the limbs are very common, and are often due, probably, to small hæmorrhages into the muscles and other tissues of the part. The urine and other secretions appear to undergo no important alteration.

Diagnosis.—Hæmophilia in its traumatic form, or when it is both congenital and hereditary, can be mistaken for no other disease. Difficulties in diagnosis arise when a tendency to spontaneous bleedings appears in a member of a healthy family. If the diathesis show itself within the first two years of life, and especially in a male child, the disease is probably hæmophilia. The diagnosis is more doubtful in the case of a girl, or when the tendency appears at a later age.

A hæmorrhagic diathesis, in women who are not of a bleeder family, must not be taken for hæmophilia unless the hæmorrhages has begun during early childhood. In the case of umbilical hæmorrhage, the diagnosis would turn on the presence or absence of hereditary disposition.

Hæmophilia can scarcely be confounded with purpura or scurvy, which are transitory disorders, and are neither congenital nor inherited.

Treatment.—A bleeder must of course be protected as far as possible from all accidents, and should avoid excitement of any kind. A nutritious and digestible diet, without alcohol in any form, warm clothing, gentle exercise, and residence in a temperate climate are desirable. Vaccination should not be omitted. No woman in a bleeder family, whether she be a bleeder or not, and no man who is himself the subject of the disease, ought to marry. The treatment of the hæmorrhage is generally unsatisfactory. Complete rest in bed is to be insisted upon invariably. Although internal medication alone avails little, it seems well to combine the use of drugs, like acetate of lead, ergot, turpentine, &c., with local applications, whenever it is feasible, and to administer a saline purge. Frequently, however, all treatment fails, and the patient bleeds to death. At other times the bleeding stops of itself after profound anæmia, or even syncope, has been induced. In traumatic external hæmorrhage the part should be elevated, and careful pressure applied with a pad steeped in liq. ferri perchlor. It must be remembered, however, that excessive pressure is liable to cause gangrene. Ligature of a large artery has only once been successful hitherto, and cannot be recommended. Experience of the use of the actual cautery is not encouraging. In spite of its risks, transfusion seems justifiable as a last resource. The hæmorrhage resulting from extraction of a tooth should be treated by plugging the cavity with lint saturated with liq. ferri perchlor., which may be secured by a small gold plate wired to the adjoining teeth. Ligature of the common carotid, in one case, arrested the dental hæmorrhage. Extraction of teeth must on no account be attempted in a bleeder, and warning should be given of the risk of the operation when the disease can be recognised. Subcutaneous extravasations and blood-tumours must not be opened unless gangrene be threatened, but are to be treated by rest. It is important to deal promptly with the joint-swellings by means of splints and confinement to bed, as the affection is apt to become inveterate. It is hardly necessary to state that all cutting operations are inadmissible; even such measures as leeching, cupping, and blistering should be avoided.

Percy Kidd.

HÆMOPTYSIS FROM INJURY.—The spitting of blood which takes place after injury to the chest is almost certainly pathognomonic of some lesion of the lung or trachea. It is characterised by the expectoration of frothy light-red blood, which, from being mixed with a large proportion of mucus, but rarely coagulates. Its amount is seldom large, and its colour speedily changes to the rust-red of pneumonic sputum. Should any very large amount be expectorated, it should lead to the suspicion of some previously existing cavity or tubercular disease of the lung. A penetrating wound involving the trachea and some large blood-vessel may, however, give rise to extensive hæmorrhage, which is coughed up, and thus simulates hæmoptysis. The bleeding in such a case is not exactly like an ordinary case of hæmoptysis. Although the blood is coughed up, it comes away more in gushes, is less frothy and deeper red in colour than in hæmoptysis, and has a greater tendency to coagulate. This arises from the blood of true hæmoptysis being more mixed with the mucus and air of the lung than in the cases where it comes from a wound in the trachea.

The blood of hæmoptysis may be distinguished from that coming from any other source by its light-red, frothy character, showing that it has been intimately mixed with the air of the vesicular tissue of the lungs. This admixture never takes place with the same completeness, even when the bleeding takes place from any other part of the air-passages. Thus the hæmorrhage of epistaxis is often abundant and florid in colour, but does not possess the frothy character. On the other hand, blood coming from the stomach or throat scarcely ever is florid, and is never frothy. Blood from the stomach is generally more or less dark in colour, in accordance with the length of time it has stayed in that viscus; and when it has been there sufficiently long to undergo the action of the gastric juice we get the well-known coffee-ground or black vomit of hæmatemesis.

The *treatment* of hæmoptysis from injury will be found detailed under PNEUMONIA, Traumatic. H. G. HOWSE.

HÆMORRHAGE.—This signifies the loss of blood from some part of the arteriovenous system. It need not necessarily flow out of the body, for bleeding, even to a fatal amount, may occur without external lesion. Sometimes, for instance, it will flow into one of the natural cavities. Thus the pleura or peritoneum may be distended with blood, constituting what is known as internal hæmorrhage; or blood from a ruptured vessel may be effused into the neighbouring areolar tissue, a condition known under the name of extravasation.

Bleeding may occur from arteries, veins, or capillaries. Arterial hæmorrhage is, as a rule, the most serious, owing to the high blood-pressure in the vessels, and thus, in a given time, a far larger amount of blood is lost from an artery than from a vein of the same magnitude; nevertheless a fatal hæmorrhage may readily occur from a wounded vein of any size. Capillaries or minute vessels, when injured, bleed freely for the moment, but rapidly close and the bleeding ceases. To this rule, however, there is sometimes a remarkable exception, and occasionally an uncontrollable hæmorrhage occurs from vessels too minute to be recognised by the naked eye. The peculiar constitutional state that leads to this form of capillary bleeding is known under the name of the HÆMORRHAGIC DIATHESIS.

Patients with this diathesis will bleed persistently from the slightest injury. The blood does not flow rapidly away, but escapes as a continuous slow oozing, and the writer has seen a case of death in these circumstances following a cut on the lip of the most trivial nature. In the victims of this diathesis capillary bleeding not only takes place from external wounds, but extensive subcutaneous extravasations occur from the slightest violence, or even spontaneously. In such patients the strain of a joint, instead of being followed by a synovial effusion, may cause the membrane to be filled with blood, while a blow so slight as not even to bruise a healthy person, will often, in such a constitution, be followed by an extensive discolouration and subcutaneous extravasation, a circumstance which may be usefully borne in mind in some cases of medico-legal inquiry.

CLASSIFICATION OF HÆMORRHAGE.—Surgeons generally classify hæmorrhage into primary, recurrent, and secondary.

Primary Hæmorrhage is that which takes place when a vessel is first wounded.

Recurrent Hæmorrhage. — Some confusion has arisen between the terms secondary and recurrent hæmorrhage, but a clear distinction is very necessary, not only as indicating a different pathological condition, but, also, as materially affecting the question of treatment. Recurrent hæmorrhage is the bleeding that recurs soon after an operation, generally speaking within twelve hours; very rarely it may happen as late as the second day. It is due to some vessel or vessels which have ceased bleeding at the time of operation, thus escaping ligature, but from which, when the patient becomes warm in bed and reaction is established, blood begins to flow. Recurrent hæmorrhage is not, as a rule, sudden and severe, like secondary hæmorrhage, for the vessel furnishing it is generally small. The blood begins slowly to trickle through or by the side of the dressings; or, if the wound has been united without a drainage-tube, the flaps will be slowly distended and separated.

Secondary Hæmorrhage.— This is the bleeding which occurs several days after an operation. It results from the obliteration of a vessel not being complete at the time the ligature separates, or from the vessel being opened by some sloughing or ulceration in its neighbourhood. The period of its occurrence depends upon the size of the vessel; the larger the vessel, the later, as a rule, secondary hæmorrhage occurs. In an artery the size of the femoral, it is generally between the tenth and the fifteenth day. The blood in these cases is often furnished by the main vessel, and it generally flows suddenly, in considerable quantities. Although the actual onset of the bleeding is sudden, it may be preceded by a slight staining or rust colour of the discharge, so that when a large artery is involved, the surgeon should be on his guard when the discharge becomes discoloured or blood-stained. Recurrent hæmorrhage, being due to mechanical causes, may occur in the most perfectly healthy individual. Secondary hæmorrhage, on the other hand, is only liable to happen in those who have some defective condition, either of the vessels or constitution, retarding the proper healing of the wound. Thus it is found that patients with either calcareous or atheromatous degeneration of their arteries are peculiarly liable to this accident; while drunkards, or others with broken constitutions, possessing tissues easily inflamed and slow to repair, are likely subjects for secondary hæmorrhage.

SYMPTOMS OF HÆMORRHAGE.—The symptoms of bleeding are both local and general. The local symptoms, if an external wound exist, are obvious, and it merely remains for the surgeon to distinguish whether the source of the blood be venous or arterial.

DIFFERENCE BETWEEN ARTERIAL AND VENOUS BLEEDING.—Arterial may be distinguished from venous hæmorrhage by observing the following points:—

1. The colour of the blood. 2. The method of its flowing. 3. The amount and position of pressure necessary for its control.

1. *Colour of the Blood.*—Blood from an artery is of a bright scarlet, while that from a vein is claret-coloured or purple. There are certain exceptions, however, to this rule. If the patient be under the influence of nitrous oxide gas or ether, the arterial blood becomes so dark as to resemble venous bleeding, while, on the other hand, venous blood, if trickling slowly from a wound, becomes much brighter than normal from its prolonged contact with the air.

2. *Method of Flowing.*—Blood from an artery escapes in pulsatile jets, synchronous with the heart's beat. In a deep wound, by the time the blood comes to the surface it probably no longer spouts, the intermittent stream having been converted into a more or less constant one, owing to the wound itself acting as a reservoir; but, even here, although there is no actual jetting, the stream has a pulsatile flow. Blood from a vein escapes in a steady continuous stream. It should be borne in mind that, although the flow from a vein is continuous, if the wound into it be small, and if there be any pressure between it and the heart, the jet of blood may be thrown out a considerable distance, a phenomenon illustrated by what occurs when a vein is opened for the purpose of bleeding.

3. *Effects of Pressure and Position.*—Arterial bleeding is only affected to a limited extent by position, or stopped by a considerable amount of pressure. On the other hand, venous bleeding nearly ceases on simple elevation of the part, while it can be completely arrested by a slight amount of pressure. Firm pressure over the main vessels of the limb will generally arrest bleeding, whether venous or arterial; but slight pressure of the part above the wounded vein immediately increases the flow, which at once stops on the same amount of pressure being exercised on its distal side.

When blood is extensively extravasated into a limb, the whole member becomes swollen, and has a tense, elastic feel, while the skin is usually mottled and discoloured with venous congestion. If the hæmorrhage be from the main artery, the limb is often cold, with diminished sensibility, while there is loss of pulsation in the vessels below the injured trunk, and not infrequently such cases run on into gangrene. It might be supposed that, when blood was thus extravasated into a limb from a wounded artery, there would be pulsation in the swelling; but this is rarely the case. This absence of pulsation is probably due to the cessation of the bleeding, or to its flowing but feebly at the time of examination.

In internal hæmorrhage the local symptoms depend on the situation of the bleeding. Thus, when the pleura is filled with blood, there will be physical signs of fluid in that cavity. In the peritoneum the local symptoms are often very obscure. If the hæmorrhage be extensive, there will be dulness in the flanks, as in dropsical effusion, for it must be remembered that the blood does not at first coagulate in serous sacs. In two instances of fatal hæmorrhage into the peritoneal cavity, which the writer had an opportunity of observing at St. Bartholomew's Hospital, there was considerable abdominal distension, while, in both cases, the vomiting was so persistent as to suggest the idea of intestinal obstruction.

GENERAL OR CONSTITUTIONAL SYMPTOMS OF HÆMORRHAGE.— These require to be carefully considered, for they often have to be solely relied upon for the diagnosis of internal bleeding, while, even in wounds, they form a valuable guide as to the amount of blood lost. The effects of bleeding depend, not merely on the amount but, in some measure, on the rapidity of the flow; thus, a sudden loss of blood, occurring in a few seconds from a large vessel, produces a constitutional effect far more marked than an oozing of the same amount extending over some hours. Individuals, too, bear bleeding very differently. Speaking generally, infants and young children bear hæmorrhage badly, and the same relative loss of blood that can be borne with impunity by a healthy adult, may, at the extremes of life, lead to a fatal termination, while patients, already debilitated by illness or previous hæmorrhage, often succumb to even a trifling loss of blood.

Constitutional Symptoms of Sudden Hæmorrhage.—Fainting, shock, or collapse is the first prominent effect on the body of a sudden copious loss of blood. The patient loses consciousness, and falls to the ground in a fainting fit. If the loss of blood be but slight, he will remain in this condition for a few seconds only, but if severe he may be in a state of collapse, hovering between life and death for a considerable period. The pulse is absent at the wrist, or at the most gives but an intermittent feeble pulsation. If the stethoscope be applied over the heart, its sounds will be scarcely audible, while its working is irregular and intermittent. Respiration is almost suspended, requiring close observation to detect the movements at all, the inspiration being extremely shallow and wholly diaphragmatic—occasionally, however, relieved by sighing or yawning. The extremities are cold and damp, while the face is bathed with a clammy sweat. Muscular debility is almost complete; even the power of the levatores palpebrarum is lost, the lids drooping over the half-closed eyes; a deadly pallor pervades the surface of the body, the blanched, bloodless condition of the lips, finger-nails, and conjunctivæ bearing unmistakable evidence of a failing circulation.

Should the case end fatally, the pulsations grow feebler, and the breathing more and more shallow, death stealing over so gradually that the exact moment of dissolution escapes observation. Even after the heart has apparently ceased to beat, a faint, quivering throb may now and again be detected for some minutes. In other fatal instances the patient rallies somewhat from his first collapse, and the condition of complete muscular debility is replaced by extreme restlessness. The sufferer tosses from side to side, vainly seeking repose, and it is with great difficulty that he can be kept quiet. It may so happen that the restlessness decreases as the patient gradually regains strength, or it may be but the prelude to a second collapse from which he never rallies. It is often many days, or even weeks, ere the patient recovers from the effects of severe bleeding, while elderly people sometimes never really recover, dying some months later from intercurrent disease starting in a constitution already debilitated by hæmorrhage.

Constitutional Symptoms of Chronic Hæmorrhage.— The symptoms of chronic hæmorrhage, which arise from small losses of blood frequently repeated during many weeks or months, are very characteristic. The whole complexion slowly assumes a faint yellow or waxy hue. The pallid lips and the blanched conjunctivæ clearly indicate the anæmic condition of the tissues. Muscular weakness, shown by a distressing breathlessness upon the slightest exertion, is always present, while the sudden assumption of the erect position produces giddiness or fainting. The lower limbs are apt to become œdematous, and the pulse, excessively soft, constantly exceeds its normal rate, while palpitation follows on any exertion. Noises in the head are commonly complained of. In these cases of chronic hæmorrhage the blood is at first of normal constituency, but it gradually becomes thinner and, from a diminished proportion of its solid constituents, grows so watery as rather to resemble a red-stained serum than the natural fluid.

NATURAL MEANS BY WHICH HÆMORRHAGE IS ARRESTED.— Before considering the treatment of hæmorrhage, it is necessary to understand Nature's method of stopping bleeding from divided vessels, for it is by aiding this natural process that many severe cases are brought to a successful issue, without the necessity for any active surgical interference. Nature's method may be considered under the headings *constitutional* and *local.*

Constitutional.—During the period of collapse the action of the heart is reduced to the smallest amount, the pulsations becoming so feeble as barely to keep the blood circulating. The blood accordingly ceases to flow from the wound, and thus the patient is prevented from at once bleeding to death when an artery of any magnitude is divided. During this temporary respite, time is allowed for those earlier changes to take place in and about the wounded vessel, which form the first line of defence against the recurrence of bleeding as the heart regains its power.

Local.—These affect both the vessel and the blood. An artery upon being divided at once retracts, from its elasticity, a short distance within its sheath, while, owing to the contraction of its circular muscular fibres the end becomes conical, thus materially diminishing its calibre at the divided point. The changes in the blood consist of the formation of coagula known as the temporary and permanent clots. The temporary clot is a simple coagulation of the blood. It appears to commence on the inner margin of the sheath, and, quickly increasing, only leaves a narrow channel through its centre, which channel rapidly becomes blocked up. Coincidently with this coagulation within the sheath and about the wound, the clot extends upwards within the vessel itself as high as the nearest collateral branch, closing the vessel by a soft blood-coagulum. The protection afforded by this temporary plugging of the vessel doubtless depends upon the distance to which the clot extends. Sometimes it is so slight as to be immediately washed away as the patient rallies; but often, frail as the protection may appear, it is sufficient to guard against bleeding until Nature has time to construct a more permanent barrier.

Permanent Clot.—If a divided artery be examined twenty-four hours after the cessation of bleeding, it will be found that a marked change is taking place in the constituents of the temporary clot. At its base —that is to say, at the line of the divided coats of the vessel—the clot has a whitish appearance, so that at this time it may be described as possessing a light-coloured base, which during the next forty-eight hours has extended upwards into the red blood-coagulum, causing, by the end of the fourth or fifth day, its total absorption. Under the microscope it can be seen that this white coagulum consists mainly of leucocytes, which have been climbing as it were into, and dissolving, the original blood-clot. The source of these leucocytes is apparently from the cut edges of the vessel, to which the base of the permanent clot is from the very first adherent, though there is some question as to whether they may not be in part derived from the endothelium lining the vessel. At any rate the endothelium rapidly disappears, the leucocytes of the clot becoming ultimately adherent to the inner coats of the vessel. The development of these leucocytes into fibrous tissue ultimately transforms the artery, as high as the nearest large branch, into a permanent fibrous cord.

By a proper understanding of the process just described, the successful treatment of hæmorrhage is more likely to be effected, since it explains why pressure, if properly applied, by allowing time for nature to seal the vessels with lymph, is often so successful a method of dealing with arterial hæmorrhage.

TREATMENT OF HÆMORRHAGE.— This resolves itself into the general treatment of the shock or collapse induced by the bleeding, and the local measures required for the arrest of the hæmorrhage.

Treatment of the Collapse.—If the collapse induced by hæmorrhage is marked and profound, and the patient in the condition already described, the greatest care and gentleness will be demanded; for he is so near the invisible boundary dividing life from death, that neglect of the slightest precaution may place him for ever beyond the reach of surgical aid. To expose or roughly handle such a patient, or, above all, to lift him suddenly from the recumbent to the sitting or upright posture, is to court disaster. In hospital practice such a patient should on no account be lifted off the stretcher, but should be carried to the ward, and the stretcher be placed with a screen round it before the fire. The clothes must be rapidly cut off and the body covered with warm blankets, it being of extreme importance that the head be not raised or the body pulled about.

If the bleeding vessel has already been secured, the indication for treatment is to bring about reaction. Hot bottles may be placed between the thighs, under the arms, and over the pit of the stomach. The lower limbs should be slightly raised on pillows, so as to allow the blood to gravitate as much as possible towards the body. Hot dry flannels may be applied over the chest, while a sponge wrung out of very hot water may be placed over the region of the heart. Equal parts of hot brandy and water may be given. This should be done extremely slowly, drop by drop, on a quill pen. If given hurriedly it cannot be swallowed, and will run into the larynx. In extreme cases a subcutaneous injection of a few minims of ether by a hypodermic syringe has proved serviceable, while if the patient show no signs of rallying, direct transfusion of from four to six ounces of blood may be tried. *See* TRANSFUSION.

If, however—as is not uncommonly the case—the collapse is due to violent hæmorrhage from some punctured wound of a deep vessel, which has spontaneously ceased to bleed before the surgeon's arrival, he should not be in too great a hurry artificially to bring about reaction. There is no time when an efficient coagulum is so likely to form as during the collapse immediately succeeding a sharp hæmorrhage, for, at this period of feeble circulation, the coagulum is not merely forming around the wounded orifice, but it is extending within the canal of the vessel itself, and every minute gained makes it stronger. Unless the collapse be very profound, surgeons should be satisfied with merely covering the patient with warm blankets. Brandy should on no account be given. Artificially to excite by stimulants a more powerful action of the heart is in these circumstances fatal. Nature has done her best to reduce the heart's power, and, if time be given, an effective clot will be formed; while a premature reaction, brought about by stimulants, may be followed by a breaking up of the clot and a recurrence of the bleeding. Urgent thirst is a common symptom of severe bleeding, and there is no reason why the sufferer should not be allowed a moderate amount of cold water, and small pieces of ice to suck are often specially grateful.

Local treatment of hæmorrhage.—The treatment of arterial bleeding will be found under ARTERIES, Wounds of; the milder forms of hæmorrhage from the veins or capillaries will be here considered.

TREATMENT OF VENOUS BLEEDING.—In an open wound there can be no doubt that bleeding veins should be tied. The old fear of inflammation following ligature of the veins has long since been proved to be utterly groundless. In punctured wounds, elevation of the limb on a pillow with a moderate amount of pressure directly over the bleeding point, or on the veins a little below it, effectually arrests the hæmorrhage. The use of the tourniquet or bandaging above the wound should on no account be permitted.

The veins of a limb can be closed by a far less amount of pressure than is required to arrest the circulation through the arteries, so that if a circular bandage or tourniquet be not applied so firmly as completely to stop the arterial circulation, it will, to a certainty, increase the venous bleeding, for the blood finds its way into the limb and cannot return. The blood thus retarded flows out through the wounded veins. It may be frequently observed that a severe hæmorrhage from a wound is at once stopped by removing all bandages and compresses which have been applied above the wounded part. Shortly, then, it should be borne in mind that the very pressure over the main vessels of a limb, so efficient in arterial wounds, may actually prove fatal to the patient, if employed for venous hæmorrhage. If a large vein has only been punctured, it will suffice to pick up the portion wounded and tie it without including the whole calibre of the vein. A wound of one of the intracranial sinuses by the trephine, or a compound fracture, bleeds very copiously; nevertheless it can be easily restrained if the patient's head be raised and the most moderate amount of pressure applied locally.

CAPILLARY BLEEDING.—This does not mean that the hæmorrhage necessarily proceeds from the actual capillaries, but that it flows from vessels too small to be distinctly recognised as arteries or veins. Thus it will sometimes be observed that, after an amputation, especially when an Esmarch's bandage has been used, after all visible vessels have been secured, blood will continue to ooze from a number of minute points. Hæmorrhage of a similar nature occasionally follows the evacuation of an abscess, from the minute vessels in its walls losing their support. It is in patients with the hæmorrhagic diathesis that a serious or even fatal bleeding may result from the division of the minutest vessels.

The troublesome oozing which may occur from the surface of a wound will nearly always cease when the sides are brought together or the flaps adjusted, but it is sometimes undesirable to close a wound when the oozing still continues. It is a common practice to dash cold water over the surface, but if the wound has been long exposed, and the surface is already cold, this often aggravates rather than restrains the bleeding. In these circumstances nothing answers better than rapidly bathing the stump with hot water. The temperature of the water should be 120° to 124°, that is, just about as hot as can be borne by the hand.

A troublesome bleeding sometimes occurs, in amputation, from the medullary canal of a bone; this can be stopped by pressing a small piece of beeswax into the spot. Capillary oozing is sometimes kept up by the presence of a clot, and a wound that has been dripping for some time will cease to do so if the coagulated blood be gently sponged away. The free exposure of the bleeding surface to the air is often a valuable resource in arresting general oozing, especially if care be taken that all clot be wiped away. Whether the exposure acts directly on the vessels or on the blood is unimportant; but it is certain that an oozing which has been continuing for a length of time may quickly cease, on exposing the flaps or surface of a wound freely to the air. In the oozing from an abscess-cavity it will frequently happen that, on washing out the collected blood, the bleeding will cease.

Pressure, carefully applied and evenly adjusted, is a form of treatment applicable to many cases of capillary bleeding, while, in positions where it cannot be applied, syringing with hot water should certainly be tried. Should this prove ineffectual, the wound may be washed out, or the abscess-cavity syringed with a solution of the subsulphate of iron, or, failing this, the wound may be touched with the actual cautery; while, as a last resource, and one that would very rarely have to be applied, the cavity may be plugged with strips of lint dusted with the subsulphate of iron powder.

For treatment of arterial hæmorrhage, *see* ARTERIES, Wounds of.

HARRISON CRIPPS.

HÆMORRHAGIC DIATHESIS. *See* HÆMOPHILIA.

HÆMORRHOIDS.—A varicose condition of the veins of the anus and adjacent part of the rectum. The term is etymologically bad, as it refers to the hæmorrhage, which is only one, although often the chief, of many symptoms which characterise some forms of this disease. Piles, from the Latin *pila*, a ball, is better, as most of these varicosities present, at some time of their existence, a somewhat globular form.

Piles may be classed as external, intermediate, and internal, according to their situation, outside, on the margin of, or inside the anal orifice. This classification is practically useful, for the symptoms and requisite treatment will vary with their situation.

They occur very frequently, and few persons attain to old age without having them in some degree. This is explicable from the anatomy of the part. The anus and rectum being developed from different parts of the embryo, are supplied with blood from separate sources, and return it by separate channels. The rectum is supplied by the superior hæmorrhoidal artery, and the blood is returned by the corresponding vein, a radical of the portal vein. The anus and contiguous part of the rectum are supplied by the middle and inferior hæmorrhoidal arteries, and the blood is returned by the corresponding veins, radicals of the inferior vena cava. There is a free capillary communication between these vessels, so that any obstruction to the flow of blood through the portal vein or the inferior cava tends to produce passive congestion of this part of the bowel. This is further favoured by gravitation, as the veins of the portal system are valveless. Moreover, the submucous tissue of the rectum is very lax, to allow of the adaptation of the mucous membrane to the varying condition of the tube, which is sometimes completely closed, and at other times, during the passage of fæces, more or less considerably distended. The veins, therefore, in this tissue are less capable of resisting increased blood-pressure than in other parts. Thus, constriction of the mitral or tricuspid orifices of the heart, pulmonary emphysema, chronic bronchitis, cirrhosis of the liver, or abdominal tumours, may induce piles. The straining resulting from habitual costiveness, or from stricture of the rectum or of the urethra, or from enlargement of the prostate gland, is a frequent cause. The gravid uterus very frequently produces passive congestion of the rectum, and so causes piles. Active congestion of the part may be induced by constipation, unsuitable purgatives, high living, abuse of alcohol, venereal excess, and, in women, by uterine or ovarian affections. In some cases there appears to be an hereditary tendency to piles; but, as Esmarch well remarks, the tendency to excesses by which piles are produced may also be hereditary in these cases.

The *treatment* of piles must be general as well as local, and unless the exciting cause can be adequately dealt with, the local treatment can only be palliative. As a rule patients with piles may be advised to carry out Falstaff's resolve 'to purge, and leave sack, and live cleanly.' The purgative must not be irritant, and the confection of senna, or Carlsbad water, taken before breakfast, will usually suffice. The rectum should be injected with cold water after each motion. These precautions, with attention to diet and moderation in the use of alcoholic stimulants, will generally check the development of piles, unless there be some persistent obstruction to the return of venous blood, when the treatment must, so far as possible, be directed to the cause as well as to the result.

External piles commence as a dilatation of the subcutaneous network of veins around the anal orifice. As the integument is thin, the dilatations form livid projections, which are soft and easily compressible. If the congestion continue, it produces infiltration and chronic inflammation of the surrounding tissue, which subsequently undergoes cicatricial contraction, and so compresses or even obliterates the dilated veins. Firm incompressible folds of skin remain, which, if uncomplicated, and if due attention be paid to cleanliness, usually cause no trouble. They may produce pruritus or eczema, and sometimes become inflamed and painful. If so, they may be cut off with scissors curved on the flat. But if they are near the margin of the anus, care should be taken not to remove too much skin, or a troublesome stricture of the orifice may result. Sometimes one vein becomes considerably dilated. Thrombosis usually results, and the nodule, from its size, may cause inconvenience and is liable to irritation. It may become inflamed and suppurate. A longitudinal incision should be made in the pile and the clot be turned out. Some cotton wool should be placed in the wound and the patient should rest for the remainder of the day, for fear of hæmorrhage. The skin need not be removed, as in cicatrising it will contract.

Intermediate piles also result from passive congestion of the veins. If chronic, it induces hypertrophy and thrombosis. From their situation, at the margin of the anus, these piles are exposed to irritation and often becomes inflamed. As they are covered partly with skin and partly with mucous membrane, the latter may ulcerate, and so cause a purulent discharge or hæmorrhage. They often excite tenesmus, and there may be great pain during and after defecation, but this is not so severe or persistent as in so-called fissure of the anus, which, however, sometimes is a complication of this variety of piles. If their removal be contraindicated, ice will relieve the inflammation, and the dilute nitrate of mercury ointment is a convenient application when they are ulcerated. Otherwise they may be excised with scissors, but, lest stricture of the orifice should result, it is better to remove only two-thirds of each pile, and the remainder will shrivel in cicatrization.

With internal piles there is usually active as well as passive congestion of the mucous membrane. As they are abundantly supplied with arterial blood they are of a bright red colour, and bleed very readily. There is often much mucous discharge. The veins are convoluted as well as dilated, and the hypertrophied sub-mucous tissue around and between them forms tumours which, on microscopic examination, resemble cavernous structures. As a rule internal piles are soft and compressible; but sometimes the hypertrophied sub-mucous tissue may become indurated, and the pile may resemble a fibrous polypus, from which it can be distinguished only by microscopic examination.

Internal piles may be sessile or pedunculated. The latter often protrude through the anal orifice during defecation, and their replacement is painful. It is usually effected by the fingers of the patient, or better by pressure with a soft sponge. In these cases the patient should arrange so that the daily action of the bowels should take place at bedtime, as the piles can be more easily replaced when the patient is in the recumbent posture, and the maintenance of this position during the night, and the dilatation of the cutaneous vessels from the warmth of the bedclothes, relieve the congestion of the bowel. Sometimes the protruded piles are strangulated by the sphincter muscle, and then sloughing and gangrene may result.

Internal piles, in an early stage, cause irritation and a sensation of heat in the fundament, especially after defecation. Sometimes there is mucous catarrh of the rectum. As the piles enlarge, and the mucous membrane atrophies from pressure, there is usually hæmorrhage. This may vary in amount, being sometimes slight, at other times considerable. If it be venous, resulting from congestion of the heart, lungs, or liver, the patient will be relieved. But if it be arterial, from active congestion of the bowel, it is injurious, and, if long continued, in neglected cases will produce symptoms of extreme anæmia.

The *diagnosis* of piles presents no difficulty. Perineal vegetations, condylomata, and cancerous tubercles, can scarcely be confounded with external piles, and the history of the case will prevent the possibility of such a mistake. Protruding internal piles are distinguished, by their irregular outline, from the uniformly annular protuberance of smooth or rugose mucous membrane in prolapse of the rectum. Such piles, however, are often accompanied by genuine prolapse of the rectum. An indurated internal pile, with narrow pedicle, greatly resembles a fibrous polypus, but the distinction is unimportant, as the treatment of both is the same—ligature of the pedicle and abscission of the growth. In fact, most internal piles are genuine new-growths of a nævoid character.

Treatment.—Daily injection of cold water and attention to diet and general health will suffice in many cases. Astringent injections are sometimes of service. They should be small in quantity, and should be administered at bed-time, so as to be longer retained and to act more thoroughly. The tincture of Hamamelis, one drachm to three ounces of cold water, is said to be useful. A suppository of the dilute nitrate of mercury ointment is useful in cases of catarrh. If there be arterial bleeding, it must be checked by operation. For this purpose sessile piles should be painted with nitric acid or the acid nitrate of mercury solution. The surface of the pile should be dried with cotton wool and the acid applied with a glass brush, but care should be taken to prevent the acid coming in contact with the margin of the anus, as this would cause great pain. The surface of the pile should then be again dried, and some carbolized olive oil (1 in 20) be applied. The patient should maintain the recumbent position for some hours after, and if there be much pain, ice applied to the part will give relief. Sessile piles may also be advantageously treated with the actual cautery.

Pedunculated piles may be removed by ligature or by the actual cautery. An aperient should be administered on the preceding evening, in order that the rectum may be empty, and an injection of warm water, immediately before the operation, will assist in bringing the piles well down. The patient should lie on the left side, with the thighs well flexed, and a strap, passed round the shoulders and under the right thigh, is very useful. The nates should be separated by an assistant. If the ligature be adopted, the pile should be seized with a pair of four-toothed forceps, and a groove cut in the mucous membrane at the lower border of the base of the pile with blunt-pointed scissors. The groove should be perpendicular to the wall of the bowel. The forceps should then be transferred to the assistant, who should make gentle traction on the pile at the moment when the loop of ligature is about to be tied round the base of the pile. The ligature should be of well-waxed hemp, and be tied as tightly as possible. The ends should be cut moderately long. If the base of the pile be broad, a curved needle, armed with the ligature, should be passed through the centre, and, the loop having been cut, the pile should be tied in two parts. If there be more than one pile, the others should be treated in a similar manner. The piles and the ends of the ligatures should then be passed up above the sphincter muscle, and, unless contraindicated, a morphia suppository should be introduced. Any external or intermediate piles should be cut off. Otherwise, however insignificant they may appear, they will almost certainly become inflamed and cause trouble to both patient and surgeon. The patient must remain in bed, and the bowels be kept inactive for some days. The diet should be simple and such as will not leave a bulky residuum. Alcoholic stimulants should be avoided. On the fifth morning some castor-oil or similar aperient should be given, and an injection of olive oil will facilitate the action of the bowels. The ligatures usually come away with the first motion, but if this does not occur, they should not be meddled with, as hæmorrhage might result. If the motion cause much pain, the use of a warm hip-bath will give relief. The patient should maintain the recumbent position until the part has healed, which usually occurs in about three weeks. If the wound be indolent, the compound tincture of benzoin or dilute solution of nitrate of silver (two grains to the ounce), are suitable applications.

If there be much pain after the operation, ice applied locally will usually give relief; but if this fail, then hot fomentations sometimes have the desired effect. If all bleeding has been thoroughly arrested at the time of the operation, there will very rarely be any recurrence if the patient be kept quiet and in the recumbent posture. Should any occur, if outside the bowel, it may be stopped by ligature, or by pressure with a pad of lint and a T-bandage. If it be from within the bowel, the piles should be drawn down by the ligatures, which were left long for this purpose, and the bleeding point touched with a pledget of cotton-wool steeped in the solution of perchloride of iron.

Retention of urine is a frequent complication. It results partly from the sympathetic congestion of the vessels at the neck of the bladder, and partly, perhaps, from the patient's inability to micturate in the recumbent posture. A catheter must, if requisite, be used, and the patient should not be allowed to sit or stand up, as hæmorrhage would most probably result. The difficulty is not experienced in all cases, and rarely persists for more than one or two days.

The inguinal lymphatic glands often become swollen and tender. They very rarely suppurate. If they do, a puncture should be made as soon as fluctuation can be detected, and, the pus having been discharged, the wound heals rapidly.

Pyæmia and tetanus, occasionally, but very rarely, result from this operation. All surgeons, who have had much experience in operating for piles, have probably met with such results ; but the fatal cases are very few in comparison with the number of operations. Some surgeons employ antiseptic measures, such as antiseptic ligatures, washing out the rectum with carbolised water, salicylic wool, &c. These can do no harm, but a careful selection of cases to be operated on will probably be more effectual. If there be evidence of extensive renal disease, operation should, if possible, be avoided, and palliative treatment adopted.

The causes of tetanus are so little known, that the surgeon has no clue as to the cases in which it may be apprehended. Statistics seem to indicate that it may result from some epidemic cause.

The treatment of internal piles by the actual cautery dates at least from the time of Hippocrates, and latterly has been adopted by many surgeons in preference to the ligature, as causing less after-pain and allowing the patient to more speedily resume his ordinary mode of life. The amount of pain, however, seems to depend more on the idiosyncrasy of the patient than on the mode of treatment; and the resumption of active life, before the part has thoroughly healed, always involves the risk of peri-rectal inflammation, and possibly of abscess and fistula. The use of the cautery does not confer any greater immunity from fatal results. The preliminary arrangements are the same as for the treatment by ligature. The base of the pile should be compressed by a suitable clamp, and the pile cut off within a little distance from the clamp. The remainder should then be burnt off down to the clamp with the galvanic, or with Paquelin's, cautery. The clamp should then be cautiously relaxed and, if there be no bleeding, removed. If there be any bleeding, the clamp must be tightened and the cautery re-applied. The after-treatment is the same as when the ligature has been used.

The method of crushing, instead of cauterising, the base of the pile, has recently been advocated, and the method seems to answer well with purely internal piles where it is desirable to avoid the loss of any blood. A very powerful screw-clamp is employed, and it is important to keep up the pressure for fully two minutes, after which the pile may be cut off beyond the clamp and the instrument removed, without risk of hæmorrhage.

Except for the application of nitric acid, which is comparatively painless, an anæsthetic should be administered in all operations for piles, unless contraindicated by the general condition or desire of the patient. The objection that the piles may slip up while anæsthesia is being induced, is groundless, as a good assistant can always, when the patient is unconscious, evert the mucous membrane so as to bring the piles into view. The volitional aid of the patient, desired by some surgical writers, is unnecessary, although sanctioned by Hippocrates, who recommended that the patient should shout loudly during the operation, so as to thrust the piles further down.

Protruded internal piles, sloughing from strangulation by the sphincter muscle, may, if the patient's condition be otherwise good, be at once removed by operation. But if, as is usually the case, there be high fever, it is better to temporise, and with hot fomentations the sloughs speedily separate, and the cure is thus effected by nature.

Jeremiah McCarthy.

HÆMOSTATICS. *See* Hæmorrhage.

HÆMOTHORAX.—A collection of blood in the pleural cavity, arising generally from injury, and very rarely from disease. The latter condition is generally due to some morbid condition of the blood, as in purpura hæmorrhagica. In such a condition, the commencement of what would otherwise have been an acute pleurisy may be here ushered in by a violent hæmorrhage into the cavity of the pleura. The course and treatment of this state will be those of the condition primarily causing the morbid state of the blood, and need not be further described here.

Hæmothorax from injury is generally due to injury of the lung or of the intercostal vessels by a penetrating wound. It more frequently takes place when the external wound is a small one than when it is large. In the latter case the blood escapes externally; when it is small, on the other hand, the wound contracts, and the bleeding cannot take place externally; it must then either collect under the skin and fascia, producing a blood-tumour, or, if the pleura be wounded, it is poured into its cavity and constitutes a hæmothorax.

A hæmothorax always causes some dulness on percussion over the affected part. The dulness may occupy the whole of the side, when the amount of blood is sufficiently great to fill the pleural cavity. In such cases there is always more or less collapse of the lung. Or the blood may occupy only a portion of the pleural cavity—generally the part most dependent after the injury has been received. Thus, if the patient has remained propped up it will be towards the base of the lung, and if he has fallen into the recumbent position it will gravitate to the side on which he has fallen. In the severer cases, there is absence of the breath-sounds on auscultation, and deficiency of the vocal fremitus. In the more localised cases, the breath-sounds are not altogether lost, but are distant and deficient in intensity; and in the slightest cases, where only a thin film of blood is effused between the lung and the costal parietes, there may be scarcely any dulness, and the breath-sounds are nearly as loud as usual. In such cases as these, the auscultatory signs are always liable to pass, in process of time, into those of the severer form, from the setting up of an acute pleurisy by the blood-clot. This is especially the case when any foreign putrefactive material has been carried inwards by a small punctured wound. The acute pleurisy thus resulting is very often accompanied by extensive serous effusion (hydrothorax), and the mixture of serum and blood thus resulting gives rise to a condition which, when seen for the first time, is very difficult to distinguish from a pure hæmothorax. The differential diagnosis may partly be made by taking into account the *rapidity* with which the dulness formed. If it came on after three or four days, it will probably be serum only slightly mixed with blood. If it formed within the first twenty-four hours, the chances are that it is blood.

Hæmothorax may be accompanied by the usual signs of a wound of the lung (*see* Lung, Wounds of), or these may be absent if the bleeding has taken place entirely from an intercostal or other large vessel. If the accumulation of blood is very great, the signs of extensive hæmorrhage will be present—viz. great collapse, pallor, thirst, a small thready pulse, and great dyspnœa. The patient sits up in bed with the body bent forwards, the surface of the skin is cold and moist, the pupils become dilated, and there is often vomiting, followed by syncope. In such cases death may take place very speedily, partly from the loss of blood, partly from collapse of the lung due to the pressure of the blood upon it. In such extreme cases measuring the chest may afford some information, the affected side bulging and being less mobile than the sound one. It is, however, a very uncertain test, and cannot be much relied on.

In the less severe cases, air may be extravasated into the chest and become mixed with the blood (pneumo-hæmothorax). In such cases the succussion-sound may be present, and may be audible either to the patient or the surgeon. In the cases which survive for some days, ecchymosis begins to appear in the lower part of the lumbar region of the chest. This is never an early sign, is sometimes not present, and is due to the blood colouring-matter gravitating from the pleura in the direction of the quadratus lumborum muscle. It gives rise to a deep purplish stain of the integuments in this region.

Treatment.—The first consideration is, if possible, to put a stop to the hæmorrhage. Operative measures to this end are too often futile, and the uncertainty where the bleeding comes from will generally render all special exploration with this end in view unadvisable. If, however, it be quite certain that it is the intercostal artery which is the source of the bleeding, an attempt should be made to secure it. On account of the freedom of its anastomoses, this should be done by tying both ends, if possible, at the wound. This is often exceedingly difficult to do, and, where it is found impossible, various special proceedings have been advised to put a stop to the hæmorrhage. Of these it is only necessary to mention one—viz. the introduction into the wound between the ribs of a piece of linen (boracic lint will answer the purpose well), pushing the centre of the piece before the finger into the wound in the form of a cone. The centre of the cone is next filled up with sublimate wool, and the base of the cone is then drawn tight over a small ring and tied. This will make the cone swell out at the sides, becoming more spherical. A slight movement of withdrawal will then cause the part in the chest cavity to press strongly against the thoracic wall, and thus may occlude any bleeding point.

If the hæmorrhage take place from any of the large internal vessels, operative proceedings are useless; but if it be from the internal mammary artery, an attempt should be made to secure it at the wound. In operating on the dead subject this artery is easily secured by opening up the space between the costal cartilages; but in the living patient, where the parts are infiltrated with blood from a bleeding artery, this is often impossible, and it may be best in such a case to cut through and remove a costal cartilage, in order the more certainly to get at the artery.

Practically, in the majority of cases, operative measures for securing the bleeding vessel will be found impossible. Where this is so, when death is impending from the large amount of blood poured out into the chest, it is best to open up the wound and introduce a large drainage-tube into the pleural cavity. The chance of saving the patient in such cases is small; but the pressure upon the lung may be relieved in this way, and the immediate risk tided over. It is said that this measure is of no use on account of the rapidity with which the blood poured into the pleura coagulates. It is, however, the only possible measure in such extreme cases, and even if fluid blood be not reached and drawn off by the drainage-tube, it is possible that some of the serum, the result of the coagulation of the blood, may be got rid of and the immediate risk from the pressure of the blood-clot be thus removed. In the cases of lesser severity it is very unwise to interfere at all with the wound. Such cases should be kept as quiet as possible, the patient placed on the affected side, the wound (if there be one) closed by some antiseptic dressing, and the effusion of blood checked as far as possible by the administration of ergot (♏x doses of the tincture every hour at first, and afterwards at increasing intervals), by the application of cold to the surface in the shape of ice-bags to the thoracic parietes, and by almost total abstinence from food. Such cases not infrequently recover, especially where there is no external wound. They may, however, be complicated by the effusion of a large quantity of serum (hydro-hæmothorax), which may call for the operation of paracentesis thoracis (q.v.).

This operation should be done, if there be an external wound, by opening it up, introducing a long drainage-tube of medium size, and allowing the fluid to drain off antiseptically below the surface of carbolic lotion (1–40) placed in a basin. The drainage-tube should never be kept in very long, and when the effusion of serum appears to have ceased, it should be withdrawn, the wound closed, and the rest of the serum and blood-clot allowed to be absorbed by the natural processes. When there is no external wound, the removal of the serum is best accomplished by the use of the aspirating syringe. A puncture should be made through an intercostal space (generally the seventh), not far from the angle of the scapula, with a medium-sized needle, and the fluid be withdrawn with the aspirating syringe. Here again it is wise not to use too much exhaustive force, and, when the fluid begins to flow with difficulty, it is best to withdraw the needle and allow Nature to do the rest. Indeed, it is better to repeat the operation a second time rather than to risk doing too much at first.

To sum up the treatment in these cases; although operative measures should be resorted to, where possible, to put a stop to the hæmorrhage, in practice it will be found that but few cases can be successfully treated in this manner, and more must be expected from the application of cold to the surface, from the internal administration of styptics, and from starving the patient, than from any operation.

H. G. Howse.

HAINSBY'S TRUSS or cheek-compressor roughly resembles a double inguinal truss. It is applied so that the pads fit on to the cheeks, which they compress towards one another; it is used to take off the strain from the sutures after operations for hare-lip.

HAIR, Diseases of the.—These may be divided into four principal groups—(1) atrophic, (2) structural, (3) pigmentary, (4) parasitic. To the first of these belong the different varieties of baldness. The structural and pigmentary changes are also for the most part atrophic, but for convenience are usually considered in separate groups.

Atrophy.—The circumstances under which alopœcia or baldness occurs are very various; in its ordinary form it is only a senile change which is very common in men, and requires no special notice.

Premature baldness may be simply due to an hereditary tendency, in which case it differs but little from senile baldness; more commonly, however, it is the result of some affection of the scalp. Amongst the most common of these is excessive sweating. It is not unusual to find that Europeans, who live in tropical countries, become partially bald owing to this cause. This kind of baldness is by no means confined to men. Various forms of follicular inflammation and seborrhœa give rise to partial baldness. *See* Seborrhœa. Most acute diseases may produce a sudden arrest of the growth and a subsequent rapid shedding of the hair; this is common, for example, after fevers. Syphilis is especially liable to produce temporary partial baldness, which may be generally distinguished from ordinary baldness by the fact that the hair falls off pretty uniformly from all parts of the head, and is by no means limited to the crown and forehead.

Scars of the scalp, from whatever cause they may arise, always produce permanent bald patches; this is the case even with those produced by erythematous lupus, where the scars are of the most superficial kind. For other forms of baldness, *see* Alopecia Areata.

Structural changes in the hair are not very common; one of the best known is called *Trichorexis nodosa* or *Tricho-clasis.*

To the naked eye the hairs affected are marked with two, three, or more white bulging spots, and very slight traction causes the hair to break at these points. Examined under the microscope, the hair presents spindle-shaped swellings of the shaft, which ultimately burst near the middle of the swelling, the cortical portion giving way first, so that the partially divided hair has the appearance of two brushes, the bristles of which are interlocked. The white appearance at the point of fracture is probably due to the same cause that gives rise to the white appearance of the scales of psoriasis—that is, the introduction of air. This form of trichorexis nodosa is chiefly met with on the hair of the face. In another variety of the same disease, first described by Dr. Walter Smith and the writer, spindle-shaped swellings occur in the hairs of the scalp, which usually break with a clean fracture between the swellings, so that the white appearance is not often seen. The growth of hair is generally very poor and feeble in these cases.

Pigmentary changes, like baldness, are often simply the natural result of old age, but premature greyness (canities) is not uncommon. Sometimes it is the result of some hereditary tendency, but more commonly it is due to bad health, anxiety, and worry. As a local cause, neuralgia may be mentioned; a long-continued or recurrent neuralgia of the scalp will often give rise to grey hair, which is distributed over the region of pain. In alopœcia areata the first crop of new hair is generally grey, and, associated with that disease, patches of grey hair are occasionally met with where the scalp has never been bald.

For parasitic diseases of the hair, *see* TINEA TONSURANS; FAVUS.

Treatment of premature baldness is confined to the use of stimulating lotions to the scalp and the internal administration of suitable tonics. The best stimulating lotions are the different preparations of cantharides; one of the most useful consists of acetum cantharidis f℥ss., glycerine fʒij., sp. rosmarini ad f℥viij. This lotion is also one of the best in cases of premature greyness; cantharides being the best local stimulant for producing an increase in the pigmentation of the skin and hair.

ROBERT LIVEING.

HAMILTON'S SPLINT for fractures of the femur is a compound of two long splints, which are united at the lower end by a crossbar; it is very useful for children, as it restrains their restlessness and allows of their being turned over without disturbing the fracture.

HAMMER-TOES.—In this affection the toes, especially the second, but occasionally the third and fourth as well, are drawn towards the sole of the foot, usually at the first phalangeal, but sometimes at the metatarso-phalangeal joint.

Causes.—These are:—(1) Crowding of the toes by ill-fitting boots. When these are too short or too small, with pointed toes, the first and fifth toes are driven under the others, which, owing to the scanty room, become displaced into the position of hammer-toes. Boots with heels absurdly high, by throwing the weight on to the front of the foot, will—especially if too small as well—have the same effect. (2) Contraction of the flexor tendons or weakness of the extensors. (3) Contraction of the digital prolongations of the plantar fascia. (4) In some cases the contraction of the toes may be partly reflex, owing to the presence of painful corns; but it is obvious that in these cases direct pressure will probably play an important part. (5) In another group of cases infantile paralysis, as indicated by the wasting, colour, and temperature of the limb, will be found to be at the root of the matter. (6) Occasionally, as in the variety of club-foot which M. Duchenne called hollow 'claw foot,' a hammer-like condition of the toes is produced by wasting of the interossei, the first phalanges being extended, while the last two are flexed upon the first. Whatever be the cause, 'hammer toes' may become a very crippling affection, especially after puberty, when more active life begins. Painful corns and bunions form over the distorted phalanges, or over the exposed heads of the metatarsal bones; and the pressure of the body is no longer evenly distributed over the phalanges, as these, from their distorted and stiffened condition, have lost their natural play.

Treatment.—This consists in first removing any cause, such as ill-fitting boots, remedying, as far as possible, by friction, shampooing, warmth, &c, the deficient action of any weakly muscles. The toes are to be straightened by means of tapes and splints. In early or slight cases these may be of whalebone, but in more advanced cases it is best to make use of a metal sole-plate, with slots cut out at the extremity, by means of which the affected toes are gradually straightened with elastic webbing or broad tapes. Such a sole-plate may be worn in the day-time within a large boot or slipper; it is always to be worn at night. In advanced cases, straightening will be impossible without the aid of tenotomy. This may be freely, if carefully, made use of in the case of contracted tendons and fascia. The former should not be divided opposite to articulations; the latter is best divided a little above the heads of the metatarsal bones. If the surgeon practise division opposite to the webs of the toes or along the phalanges, great care must be taken of the digital nerves, or troublesome numbness will result. The patient must always be prepared for some stiffness persisting in the toes—a condition of much less moment here than in the fingers. So, too, with regard to amputation, when the straightening of one or two toes proves difficult or very painful, they should be removed; this step will not interfere seriously with locomotion.

W. H. A. Jacobson.

HAMMOND'S SPLINT for fractures of the jaw is a framework of strong wire, which passes both in front of and behind the teeth at the level of their necks. The two pieces of the wire splint are laced together and to the teeth by binding wires passed between the teeth. Silver-plated copper wire does well for the framework, and finer silver wire for the binding wires.

HAMSTRING TENDONS.—*Contraction* of the hamstring muscles may be caused by painful inflammatory swellings in the ham, the pain from which is relieved by flexion of the knee. In painful conditions of the knee-joint, and particularly in 'white swelling,' and when the bones or cartilages are affected, all the muscles about the joint become spasmodically contracted; and as the flexors are more powerful than the extensors, the knee assumes the flexed position. Spasmodic contraction of these muscles is also seen in hysteria, and is occasionally excited by reflex irritation, as in some cases of phimosis. When this contraction is continuous over a long period, the muscles become permanently shortened and unable to relax to their former extent, so as to allow the joint to be fully extended: this condition is distinguished as *Contracture.* This also occurs when the muscles are permanently relaxed with their ends approximated. Thus, when in a case of morbus coxæ, the limb is allowed to remain flexed both at the hip and knee for many months, the hamstring muscles shorten, so that the knee cannot afterwards be extended.

Symptoms and Diagnosis.—These conditions are recognised by noticing that the knee-joint is constantly flexed, and that the attempt to extend it causes the hamstring tendons to start out under the skin as tense resisting cords. When only one tendon is affected, as the biceps in genu valgum, the knee can be extended, but, on attempting to bring the leg into a straight line with the thigh, the outer hamstring tendon becomes very tense. If flexion of the joint again relax the tense muscle, and the attempt at extension be met by a completely unyielding resistance always at the same angle, and if this resistance to extension persist during sleep or full anæsthesia, the condition is contracture and not simple contraction. Contracture is never established under a period of joint-flexion lasting over many months. Sayre states that it can be recognised by the fact that when the affected muscles are put upon the stretch, pressure with the finger along the tense tendons excites spasm in the muscles.

The *treatment* of contraction consists in (*a*) that of the disease causing it, (*b*) extension of the knee by some suitable splint and by weight-extension. Where the tendons are actually shortened they must be divided. *See* Tenotomy.

A. Pearce Gould.

HAND, Dislocations of Bones of the. Carpo-metacarpal Dislocations.— There is no case recorded in which all the metacarpal bones have been dislocated from the carpus. Erichsen gives a drawing of a cast he believes to have been taken from a case of the kind. It appears to be a mid-carpal dislocation forwards, of which there are well-authenticated instances, but which this author fails to describe. Hamilton mentions a case of dislocation backwards of the *four inner metacarpal* bones, caused by a bullet traversing the hand. The *second and third* metacarpal bones have been dislocated *backwards* by blows given with the clenched fist, and the second has been dislocated *forwards* by a hammer. *The metacarpal bone of the thumb* has been more frequently displaced. It may be dislocated *forwards* or *backwards.* The treatment in all these cases is to make extension on the corresponding finger and use pressure over the displaced bone. After reduction, a dorsal splint from the wrist to the end of the finger or fingers should be applied to keep the joints at rest for a fortnight. *See also* Carpal Bones, Dislocation of the.

Dislocations of the Fingers.—*Metacarpo-phalangeal* dislocations are rare, and single joints are more often displaced than the whole together. The writer has seen dislocation backwards of all the fingers at the metacarpo-phalangeal joints, caused by a fall on the fingers, associated with a transverse wound of the palm through which the heads of the four metacarpal bones could be seen. Reduction was easily effected, and the patient recovered with a useful hand. Dislocation of a *single finger* may take place in a *backward* or *forward* direction, of which the former is the more common. Of dislocation backwards there appear to be two forms: in one the phalanx is carried directly backwards and the finger is straight; the other is a dislocation by rotation of the phalanx around the head of the metacarpal bone, so that the articular surface of the former is in contact with the dorsal surface of the head of the latter. The first phalanx is over-extended and the two distal phalanges flexed. The index and little finger are, from their exposed situations, most frequently dislocated. To reduce the bone, extension should be made on the finger at the same time that pressure is put upon the projecting metacarpal head. Should reduction prove difficult, the surgeon may have recourse to the methods of treatment employed for dislocation of the thumb. *Interphalangeal dislocations* occur more frequently between the first and second phalanges than between the second and terminal. The phalanges may be dislocated *backwards*, *forwards*, or *laterally*. Backward dislocation is the most common, and may be reduced by simple extension, or by over-extension followed by flexion. The forward dislocation may be reduced by over-flexion followed by extension. Not infrequently dislocations of the fingers are compound, and in these cases the advisability of amputation or excision may have to be considered; but the surgeon should err, if at all, rather on the side of conservatism, as these dislocations are by no means always followed by stiff joints. For mechanical extension, the Indian puzzle, Charrière's forceps, or Levis's noose may be employed.

Dislocation of the Thumb.—The *metacarpo-phalangeal joint* of the thumb is more frequently dislocated than the joint of any other phalanx. The displacement usually occurs in a *backward* direction, but occasionally *forwards*. The dorsal dislocation is of two kinds: in the more common form the phalanx is dislocated by rotation around the metacarpal head, with which it forms nearly a right angle, the terminal phalanx is flexed and the metacarpal head projects towards the palm, so that in shape the thumb resembles a Z; in the other form the phalanx passes behind the metacarpal bone, so that its anterior edge rests against the back of the metacarpal head, and the terminal phalanx is straight.

Great difficulty has often been experienced in reducing these backward dislocations, even under chloroform. Various explanations of the difficulty have been put forward, but that which is generally accepted is that the expanded head of the metacarpal bone slips forward between the two heads of the flexor brevis pollicis, which grasp it and form a *boutonnière musculaire*. This is the view of Ballingall, Malgaigne, Fabbri, Vidal, and Hamilton. Hey and Dupuytren, on the other hand, attributed the difficulty to the lateral ligaments, but experiment on the dead subject almost always causes rupture of one lateral ligament, and this was found to have happened in a dissection by Lawrie of a dislocation caused during life. Pailloux, Michel, Lawrie, Roser, and, more recently, B. Anger, account for the difficulty by the interposition of a portion of the anterior ligament, which has actually been discovered in some cases. Out of three dissections, the long flexor was found on the inner side of the metacarpal head in two, and on the outer side in one. Reduction is most easily effected in the manner recommended by Fabbri. The metacarpal bone is pressed inwards and the phalanx over-extended to relax the flexor brevis. The posterior edge of the base of the phalanx is raised over the metacarpal head, and the thumb being gradually straightened, then flexed, the muscles assist in drawing the phalanx into place. Should this manœuvre fail, increased power of extension may be obtained by employing a clove-hitch of tape, the Indian puzzle, Levis's noose, or Charrière's forceps; but subcutaneous division of the outer head of the flexor brevis and any tight ligamentous band that may cause obstruction will probably be of more service. Humphrey has suggested making a small incision and introducing a blunt hook to draw the head of the flexor brevis and its sesamoid bone forward. Anger states that movements of torsion will sometimes succeed by disengaging the capsule, when all other means have failed. In cases of long standing, when the thumb is useless, excision of the joint may be practised.

Dislocation *forwards* of the thumb may be caused by falls or blows upon the dorsal surface when it is flexed. The head of the metacarpal bone projects behind, the base of the phalanx in front, and the thumb is shortened and extended. Reduction is much easier than in dorsal dislocation, and may generally be effected by flexion aided by traction upon the phalanges. Should this method fail, over-extension and traction might be employed.

Dislocation of the *terminal phalanx of the thumb* is the most common of phalangeal luxations. It may take place in a *backward* or *forward* direction, of which the former is the most common. Traction and over-extension is the method which succeeds best for reduction of the dorsal dislocation, and traction and over-flexion for the dislocation forwards. Not infrequently the dislocation is compound. If there is not much laceration such cases do not call for amputation. The writer has seen a case of compound dislocation backwards recover with a perfectly movable joint. R. Clement Lucas.

HAND, Fractures of Bones of the.—The Carpus.—Owing to its flexibility and elasticity, the gliding movement that is allowed between the various bones, and the protected position which it occupies in the interval between the larger framework of the forearm and metacarpus, the carpus is little liable to fracture. Several examples, however, of simple fracture—mostly of the scaphoid and semi-lunar bones, combined for the most part with fracture of the lower end of the radius, and produced by falls on the hand—have been recorded. Some have been due to direct violence. Compound fractures, produced by crushing, or by gunshot or other injuries, and associated with lesions of neighbouring parts, are less rare. In simple fracture it is sufficient to keep the hand and forearm at rest in a sling. In compound fractures only such fragments as are completely detached should be removed. Others must be replaced.

Prognosis is generally favourable, and should inflammation not extend to the radiocarpal joint, the movements of the wrist are not likely to be seriously impaired.

The Metacarpal Bones.—From its isolated position and wide range of movement the metacarpal bone of the thumb is especially liable to fracture; next comes the second; the third, strong and supported on either side, most often escapes; the fourth and fifth are occasionally broken. The fracture is usually situated nearer the distal than the proximal end of the bone; and sometimes is multiple, or comminuted. Generally it results from direct violence, but is sometimes produced when a blow is struck with the closed fist, or by a fall on the knuckles. In young subjects 'fracture of the neck' of these bones is usually, in reality, separation of the epiphysis, except in the case of the metacarpal bone of the thumb, which has its epiphysis at the base like a phalanx. For treatment Sir A. Cooper advised that a large ball should be placed in the palm, and that to this the metacarpus should be securely bandaged. If used, the ball must be large enough to keep the phalanges partially extended, so that the head of the fractured bone is prevented from dropping, as it naturally does, towards the palm. Another and better plan is to mould gutta-percha splints to the palmar and dorsal aspects of the metacarpus (the fingers being left free), and to bandage these, carefully padded, to each other. Treatment must be continued for about three weeks.

The Phalanges.—Fracture of these bones is a very common injury, generally due to direct violence—machinery accidents, and the like; but sometimes produced indirectly. The first phalanx, the most fixed and the most exposed, is most likely to suffer. The fracture is generally compound, and associated with laceration of the soft parts of the finger. Mobility and crepitus are easily detected; displacement is seldom very marked. In comminuted fractures, even though extensively stripped of their periosteum, the fragments will generally survive; they should, therefore, not be removed unless they are already completely loose. If a joint is opened, it will not rarely recover, with little remaining stiffness.

The treatment consists of the use of a gutta-percha splint, moulded on the finger, in a slightly flexed position, and prolonged, for the sake of support, into the palm. This may, in simple cases, be removed at about the end of three weeks, when passive motion should be employed. In compound fractures the duration of treatment must vary with the case. Howard Marsh.

HAND, Surgery of the.—In the hand may be seen very early the effects of any general wasting disease, as shown by the falling in of those parts which in health should be full and rounded, so that the bones and joints are rendered more prominent, and the skin more puckered and transparent. A clubbed condition of the finger-ends and of the nails is often found to be associated with some obstruction of the circulation, as in congenital disease of the heart or in empyema, or as indicative of a phthisical tendency. The hands of idiotic children are often ill-developed.

In the diagnosis of affections in this region, whether resulting from accident or disease, it is of the utmost importance to determine the tissue which is most deeply implicated, and this is in many cases a matter of no little difficulty. Where swelling exists, there must also be ascertained whether any acute or chronic inflammatory process is present, and if not whether any new-growth is in progress. These questions are to be determined by the characteristics by which they are recognised in other parts; but the inflammatory affections of certain tissues of this region are known by special names—e.g. whitlow, ganglion, &c., which will be found described under separate headings, and the new-growths which may be met with are detailed later on.

Atrophy of the hand occurs under many conditions, and may be either partial or complete. In cases of infantile or other forms of paralysis affecting the whole or part of the arm, or even the hand alone, a general wasting of all the component parts ensues. In short, anything which interferes with the full use of the hand will cause a certain amount of atrophy through wasting of the muscular and other tissues which contribute to its roundness and proportions. It follows, therefore, after diseases of or injuries to the bones or arteries, but such atrophic changes as are consequent upon injury to nerves are very characteristic, the glazed and hairless condition of the skin being well marked, and the claw-like deformity of the fingers unmistakable. Atrophy of the interosseous muscles (so that the fingers cannot be divaricated), of the small muscles of the little finger and of the adductor of the thumb, is evidence of loss of power in the ulnar nerve.

Hypertrophy of one hand may ensue from its more constant employment in any severe labour which calls for increased power of its muscular tissue, and an example may be found in the right hand of a racquet or tennis player, which will become considerably larger than its fellow. But the more common form of hypertrophy is a congenital condition, and may affect the whole hand or, as is more frequently seen, one or more of the fingers, the others being of the normal size. This condition is sometimes, though rarely hereditary, and may or may not be symmetrical, or similar conditions may coexist in corresponding parts of the foot. There is a general hypertrophy of all the tissues forming the part, and not of the fat only, although in some cases this is the only tissue which is exaggerated. The elongated member is usually bent to one side, and being very slightly useful, such organs are very greatly in the way.

Gangrene.—Apart from frostbite (q.v.), gangrene very rarely attacks the tissues of the upper extremity. There are, however, certain causes of this affection which should be mentioned here, although the general consideration of the symptoms, &c., will be found under the proper heading. Thus gangrene of the fingers may follow severe injuries, crushes, tight bandaging, or may result from disease or obstruction of arteries. In the museum of the College of Surgeons may be seen a hand and forearm presented by the writer, which he removed from an elderly gentleman on account of gangrene consequent upon an atheromatous condition of the vessels. Injuries to nerves, particularly the ulnar, when followed by loss of sensation and by an ill-regulated state of the blood-supply, may cause gangrene, especially if there is added some slight injury to the part affected or the depressing effect of a low temperature. The absorption of ergot is sometimes the cause of gangrene in the fingers as well as in other parts, and a gangrenous condition of the fingers may result from acute inflammation, as in whitlow or septic poisoning. An affection has been described by Raynaud and others, which occurs in children as well as in adults, in which the parts become livid and in some instances gangrenous, from, as it is suggested, a spasmodic contraction of the arterioles. *See* ARTERIES, Diseases of.

Wounds of the hand and fingers are extremely common, and in proportion to their size are attended with considerable pain and hæmorrhage. It is perhaps owing to their frequency rather than to any other cause, and also to the very extensive supply of nerves to this region, which, especially in lacerated wounds, cannot but be largely implicated, that they are so commonly followed by tetanus. Simple cuts heal readily, and the only treatment required is to carefully clean the parts and extract all foreign bodies, and then, after adapting the divided edges by strapping or other means—stitches should be avoided, if possible, on account of the additional pain—they should be dressed with mild antiseptic lotions or ointments. As a general rule hæmorrhage from the fingers can be restrained without ligature of any vessel, either by means of compresses or by careful bandaging, or by raising the hand and flexing the elbow.

Lacerated wounds occur from crushes by falling weights or in machinery accidents, and their management calls for the greatest tact and judgment. The parts may be widely torn and the edges of the wound severely contused. The pain is at first dull, but afterwards becomes acute and violently throbbing, and the bleeding may be severe. When no joint is opened and there is no fracture of bone, every effort must be made, by careful strapping or bandaging, to bring the parts closely together, after all hæmorrhage has been arrested by torsion, or ligature if necessary. Lint with some antiseptic lotion, or the complete Listerian apparatus, should be applied, and the hand, bandaged to a splint, must be kept raised over the shoulder or on an inclined pillow. Where, however, fracture of a phalanx is found, or where a joint has been opened, it is necessary, in view of the future usefulness of the part, to amputate, and this should be performed, if sufficient soft tissue can be gained to form the necessary flaps, through the joint next above the seat of injury.

The whole or part of a finger may be torn off by machinery or by being caught when the body is falling, and at the same time a long portion of tendon may be drawn out from the forearm. If it be necessary, the distal end of the remaining bone must be removed, the flaps trimmed and treated as in the case of an amputation.

Of other injuries to which the hand and fingers are liable, fractures of the bones of the phalanges or of the metacarpals are among the most frequent, and the joints are liable to simple or compound dislocation, and to sprains involving, more or less, rupture of the ligamentous tissues. These injuries have no special symptoms, but in their treatment it is important to give attention to the desirability of keeping them fixed with splints, &c., for as short a period as possible, and to the early and frequent passive movement of the joints, which, if this point is neglected, are very liable to become stiff and to be very painful under any voluntary movements.

Foreign bodies are frequently impacted in the tissues of the hand. Among the substances most frequently found are needles, pieces of iron, glass, splinters of wood, &c. The point of entrance may or may not be seen, and the body may be at some distance from it, and will often become embedded, setting up no inflammation, and only giving pain when pressed upon or from the movement of muscles with which it is in contact. Under these circumstances it is very unwise to interfere by any incision, but it is sometimes possible to push the end of a needle through the skin and thus extract it. Grave symptoms are occasionally the result of the pressure of foreign bodies upon a nerve. Thus, patients have been known to fall in a dead faint whenever the foreign body was pressed upon, or the same cause will give rise to fits or symptoms of a tetanic character. Their early removal is then of importance, and Esmarch's bandage is of the greatest possible service, since, by emptying the parts of blood, the foreign body is more easily distinguished and removed.

Inflammation in the subcutaneous tissue of the hand follows wounds of the fingers or of the palm, or may originate spontaneously. When no wound exists through which the products of inflammation can find an issue, the dense nature of the integument of the palm causes tension in this region to be attended with considerable pain. It is evidenced by thick, brawny, red swelling, often exceedingly tender, and very soon œdema, which is often considerable, appears on the dorsal surface of the hand, and upon the anterior and lower part of the forearm above the wrist. When suppuration has occurred, the matter can be seen beneath the skin, but, owing to its thickness, fluctuation is not easily to be detected at an early stage. From the disposition of the palmar fascia pus, situated beneath it, makes its way either upwards into the forearm, or downwards into the fingers, between the openings of that membrane. For the same reasons it will sometimes penetrate the interosseous spaces and present upon the dorsal surface. The lymphatic vessels generally share the inflammation, and their course is marked by red lines running up the forearm, and by swelling and tenderness of the lymphatic glands above the elbow and in the axilla. The constitutional disturbance generally runs high, and the destruction of tissues is frequently very extensive. Should pus find an entrance into the synovial sheaths, it will not only form a large fluctuating mass in the palm, but will bulge above the annular ligament by which it is confined laterally. Such inflammatory swelling can hardly be mistaken for the cold, chronic distension of the sac which constitutes a ganglion, but there is sometimes difficulty in determining the presence of matter. When circumscribed in the palm, mistakes may easily be made between it and the inflammation surrounding a thorn or other small impacted body, or suppuration of a bursa which often forms beneath the hard cuticle of labourers or artisans. *See* WHITLOW.

Treatment. — So soon as the presence of matter can be definitely ascertained, a deep incision should be made at the most tender point in the palm, where generally some yellow spot indicates the tendency of pus to come forward. If the abscess has presented above the annular ligament, a free incision must also be made parallel and internal to the palmaris longus tendon, and a drainage-tube inserted. The hand must be kept raised, and frequently fomented with hot water to which some carbolic acid has been added, and warm lotions of boracic acid should be constantly renewed, and should embrace not only the hand, but the whole of the forearm. The œdema and inflammation being subdued, no time should be lost in gently exercising the movements of the wrist, hand, and fingers, as the contraction which occurs if this is neglected forms a serious complication of the affection.

Contractions of the fingers or of the hand are found to result from burns, in which case the density of the scar-tissue renders the malady very intractable, and the same condition, in a minor degree, follows deep or extensive wounds, in which the fascia or tendons are involved. Contraction of the fingers is sometimes met with as a congenital affection, and in the subjects of hereditary syphilis. But there is a well-recognised condition in which the fascia only is implicated, and not the tendons, occurring most frequently in men, at or about the middle period of life, sometimes with a history of hereditary gouty tendency. *See* DUPUYTREN'S CONTRACTION.

Caries and Necrosis of the metacarpals or phalanges is not rare, as the result of syphilis or struma, or sometimes of severe injury or inflammation of neighbouring parts.

Dactylitis is a condition in which the medullary canal of a phalanx—generally the distal—becomes distended with inflammatory products. It may be due to scrofula, when occurring in children, and is marked by a thin, red, shiny condition of the skin, which is distended over the subjacent parts. The periosteum is thickened, and the compact tissue of the bone is destroyed; caseation with formation of pus takes place and sinuses form, through which dead bone can be felt and may be discharged. When resulting from syphilis, whether acquired or congenital, there is a gummatous periostitis, which does not always commence in the bone, but may spread from the sheath of the tendons, or from the fibrous tissues of the fingers, and is followed by softening and necrosis.

The *Dislocations* of the phalangeal, or of the metacarpo-phalangeal, articulations can only be confounded with severe sprains, and either form of injury is followed by chronic thickening of the joint. It is advisable, after either, to commence passive movement of the joint as early as possible, in order to avoid the stiffness and pain on movement which result from prolonged rest. These joints are liable to all the diseases which commence in synovial membrane or in articular ends of bone, and are more particularly the seat of the chronic affections of joints which occur as the result of gout or rheumatism, in which, as well as in arthritis deformans, the contour of the articulations is greatly altered and deformed.

Dislocations of the wrist-joint need to be diagnosed from separation of the lower epiphysis of the radius, or Colles' fracture (q.v.), and from acute effusion into the sheaths of the extensor tendons. The diagnosis may be made by noting the position of the styloid processes of the radius and ulna, which in fracture retain their normal relation with the bones of the carpus; while in dislocation the carpus is placed in front of or behind them. Disease of the wrist-joint may commence in the synovial membrane, as a result of injury, rheumatism, syphilis, or septic poisoning, but more commonly results from scrofulous disease of the carpal bones, and, from whatever cause originating, the swelling is most marked upon the dorsal surface, the hand lies semiflexed, and soon shows signs of wasting, and crepitus is detected at an early period from the destruction of the cartilages covering the bones.

Warts very frequently arise upon the hands of persons engaged in dissecting or making post-mortem examinations, but are also often found upon the fingers of children without any apparent cause. *Chilblains* very frequently occur in this region in persons with feeble circulation. The possibility of a *Chancre* must always be remembered in the case of a small obstinate sore with sluggish granulations and spongy surface, situated upon the end of the finger or at the edges of the nail in a medical man or nurse liable to contagion.

Of the affections of the nails *Onychia* needs mention here, and is a form of ulceration commencing in the matrix. The origin may be due to some slight injury, and the disease is then characterised by redness, heat, and swelling around the edge of the nail; pus soon appears underneath it, and the nail itself becomes altered in colour and is gradually exfoliated. Another form of the disease is due to syphilitic ulceration at the side of the nail, and is characterised by large granulations at the root of the nail, from which a foul sanious pus is discharged. The new nail which follows is badly formed. Treatment consists in removing as much as possible of the diseased nail, and dressing the granulations with iodoform or nitrate of lead. In the syphilitic form black wash or powdered calomel soon reduces the granulations.

The *joints* of the fingers often become enlarged, as a result of former injury, but in old persons such enlargement is more commonly due to rheumatic thickening of the ligaments. It is greatest, however, and is the source of much pain and limitation of movement, when caused by the deposit of urate of soda in the ligaments or around the ends of the bones, as occurs in persons of a gouty habit. Allied to these two conditions is the affection found in these as well as in other joints, termed rheumatoid arthritis, by which also the fingers suffer great deformity. The parts principally enlarged are the ends of the bones entering into the articulation. *See* CHRONIC RHEUMATIC ARTHRITIS.

The favourite site of cartilaginous tumours or enchondromata is found in the fingers, and they are known by their slow growth, their round nodular outline, and by the fact that, though commencing singly, they usually become multiple and affect many of the bones. Of the other tumours which are found to occur about the hand and fingers few need special mention, since the diagnosis must be based on those rules which are laid down for similar new-growths in other parts of the body.

JOHN H. MORGAN.

HANDKERCHIEF BANDAGE.— See *Esmarch's triangular bandage*, under BANDAGES.

HARE-LIP is the term conveniently used for expressing the existence of a congenital cleft in the upper lip. The term is incorrect, since in the hare the cleft occupies the exact median line of the lip, whilst in the human subject the defect is never found in the middle line, but to one side, or on both sides of it. The cause of the defect is a more or less complete arrest in the process of the development of the lip; it seems more than doubtful if the theory of 'maternal impressions' has any direct association with it. In the fifth week of fœtal life the median part of the upper lip is represented by a flap, which is descending from the front of the cranium in connection with the fronto-nasal plate. The lateral parts of the lip are developed from the coverings of the superior maxillary processes, which, extending inwards, are eventually fused with the descending flap at a short distance from the median line. If a unilateral arrest of development take place, a *single* hare-lip will be the result; but if, as less commonly happens, the arrest be symmetrical, the deformity will be *double*. This latter condition is often associated with extreme unsightliness. The cleft of one side or of both sides may extend into the nostril. Sometimes, however, the defect is represented by but a faint notch, or a slight depression on the free border of the lip. Or the apex of a slight triangular gap may be continued upwards as a slender white line, as if Nature herself had been attempting a plastic operation, with only partial success.

Hare-lip sometimes disfigures several members of the same family. Often it is complicated with cleft-palate, and the median piece of the lip, in the case of the single or double defect, may be attached, together with the intermaxillary bone, to the projecting nasal septum. Hare-lip much more frequently affects the male than the female.

The proper age for operating varies with circumstances; the child must be in the most favourable surroundings, and in the best state of health attainable. If the cleft in the lip be slight, and do not materially interfere with the infant's power of sucking, the operation may be conveniently deferred until after the weaning. If it be unassociated with defective palate, the sooner that it is closed the sooner will the infant be enabled to take the breast, and so to flourish. In such cases the operation may be undertaken with advantage and success within even a few hours of birth. Possibly at so tender an age the risks of the patient suffering from shock or hæmorrhage are greater, but for the sake both of the infant and the mother the defect should be dealt with, at any rate, within the first few weeks of cradle-life, provided that the general condition appear favourable. The early closure of the fissure has an important and beneficial influence in bringing together the sides of a palatine cleft.

Certainly it is impossible to over-estimate the importance of providing the infant with the power of feeding at the mother's breast. If the palate be widely cleft, or for any other reason the operation be deferred, unusual care and attention will be required for the infant's proper nourishment. These little patients are often brought to the surgeon in so thin and miserable a condition, that he is compelled still further to delay operation in order that their strength may be improved. When the infant cannot suck, the mother's milk should be drawn by a breast-pump and administered in a warm spoon. Failing this supply, equal parts of fresh cow's milk and water, with a pinch of salt and a little sugar of milk, should be used; and when being fed, the infant should be kept as upright as possible, so that the fluid may run easily into the pharynx. If he be sick after food it should be given in smaller quantities and at shorter intervals, and if cow's milk is being used it may be still further diluted. Condensed milk and the patent foods generally are, in the writer's experience, ill-adapted for the nourishment of these patients. The infant with hare-lip who is being reared by hand should be kept well covered in flannel, and his body and limbs should be rubbed, after the morning and evening warm bath, with cod-liver oil. The nurse who can produce a well-nourished infant, the subject of hare-lip and cleft palate, deserves high praise, many of these infants perishing from sickness, diarrhœa, and exhaustion.

Single Hare-Lip.—In every instance the operation for hare-lip demands the administration of an anæsthetic, fineness of adjustment and expedition being incompatible. Chloroform answers well, and it may be administered on a fold of lint just large enough to cover the mouth and nostrils; the stomach should be empty. The upper part of the infant's body should be wrapped round with a towel, so that the hands and arms may be fixed. In private houses a low chest of drawers forms an excellent operating-table; it should be placed in a good light. The operator will find it convenient to stand at the head of the patient, having the chloroformist on his left hand and the assistant on the right. The first, and a most important step, consists in making a superficial incision in the mucous membrane where it is reflected from the back of the lip on to the gum, and then completing the separation by tearing up the fold with the handle of the scalpel, so as thoroughly to free the lip of its maxillary attachments; this should be done to even far out on each side of the fissure.

The old-fashioned way of operating on an uncomplicated hare-lip consisted in stripping off the mucous membrane from the top of the fissure to the border of the lip on each side, and securely approximating the fresh surfaces; but by this plan the site of the original fissure was generally marked by a permanent and unsightly notch on the free border of the lip. A better plan, one which involves less sacrifice of valuable tissue, is to remove the thin strip of mucous membrane down the poorer side of the fissure, and to continue stripping off a thin layer round the blunt angle of the lip, and for a considerable distance along its free border. Then, from the opposite side of the fissure, a layer is dissected downwards; but, as the edge of the fine-bladed scalpel approaches nearer to the lower border of the lip, it should be turned obliquely, but boldly, outwards through the tissues of the lip. This having been done, a long strip hangs down from the lip, slender at the tip, but connected with the substance of the lip by a wide base. When the edges of the fissure have been brought together, this slip is bridged across the bottom of the vertical wound, and its raw surface attached by sutures of horsehair, or fine silver wire, along the border of the other side of the lip which has been already prepared for it. If this bridge do not come smoothly across the fissure, a slight extension of the oblique cut may be required. When the bridge has been carefully adjusted, all the thin tail of it which is not wanted is to be cut off in a tapering manner, so as to leave a point of mucous membrane to lie along the border of the lip. After the insertion of all necessary sutures the line of incision will look like a widely-spread inverted λ, the vertical part of which marks the site of the old cleft, a short limb extends into the conservative side of the lip, whilst the other and almost horizontal limb stretches along the opposite side of the lip, along the line of the transposed mucous membrane. In planning these incisions, care must be taken that the lines of the mucous membrane be evenly arranged. If the red flap be left deeper on one side of the lip than on the other, an unavoidable and permanent disfigurement results. For arresting bleeding from the coronary arteries during the operation, the finger and thumb of a dexterous assistant are better than any mechanical compress; the chloroformist will take charge of the left side of the lip. Blood is to be kept from getting into the mouth by the use of fragments torn from a clean sponge.

As quickly as possible a fine harelip pin is passed well through the substance of the lip, at about a third of an inch from the sides of the fissure, and reaching to the mucous membrane, so that the coronary arteries may be secured by a twisted suture of worsted or silk, not too tightly applied. A second pin is inserted higher up the lip. For a simple and narrow cleft the pins may not be absolutely necessary, but the writer invariably uses the lower one, leaving it in for twenty-four hours. If it be left in longer, a permanent scar may indicate its site. Many fine sutures are to be used, and it is important that some be inserted on the posterior aspect, the lip being gently everted for the purpose; these last sutures keep the saliva and food out of the wound. As the sutures are being inserted, the lower pin may be found to require readjustment.

The pins having been cut short with wire nippers, and the skin having been washed with a perfectly clean scrap of sponge, a morsel of lint is tucked under the ends of the pins to keep them from pricking the lip. Then a small piece of dry lint is placed over all, and secured by a piece of Seabury and Johnson's adhesive rubber plaster, cut like an hour-glass, and long enough to reach almost from ear to ear. There is much art in applying this piece of strapping. A broad end is to be firmly attached to one cheek, so that the narrow part of the strap falls over the middle of the lip; with the finger and thumb the two cheeks are to be drawn together, so that all the slack of cheeks and lip seems gathered below the nostrils, and then the other end of the strap is to be fixed in the hollow of the other cheek. In this way all strain is taken from the sutures. The cheeks being grasped in this way by the finger and thumb each time the strapping is removed, or the wound inspected, there is little risk of the parts being disturbed. Collodion is not required; it may be that its application causes unnecessary irritation.

For removing the pins it is not necessary to disturb the dressing, which by this time is forming a firm scab over the lip; the end of the pin should have been left uncovered by the strapping, so that it can easily be caught by a pair of sequestrum-forceps, and loosened by being gently twisted round, in order that it may the more easily be withdrawn. During this manœuvre the lip should be steadied by the finger and thumb. With a small piece of sponge, and a pair of dressing-forceps, the nostrils may be cleaned out from time to time. Three or four days after the plastic operation, the incrusted dressings may be cautiously detached, and one or two of the sutures removed if they have done their work. If the transplanted paring of red membrane appear loose and unsatisfactory, it must be left uninterfered with; it may require some trimming and adjustment on a future occasion. To allow the infant to suck before the fourth or fifth day would be likely to disturb the union of the paring. The invention of trustworthy and waterproof strapping has rendered unnecessary the use of Hainsby's truss for keeping together the sides of the lip.

Double Hare-Lip.—The treatment of double hare-lip is conducted on the same principles as those just enunciated. The rounded or oblong flap of skin, which descends from the nasal septum, must have its red mucous borders carefully pared off; and the outer borders of the cleft should be treated on the conservative principle, the paring being dissected downwards and left attached to the lower borders of the lip by a wide base. These two dependent flaps will afterwards be trimmed as short as may be necessary, their raw surfaces being brought together along the lower border of the median flap, to fill up the gap, and even to form a prolabium. Both sides of the fissure should be dealt with at the one operation, and two hare-lip pins will be used with advantage, but they should be withdrawn at the end of the first twenty-four hours.

Complicated Hare-Lip.—When either single or double hare-lip is complicated with a cleft palate and a projection of the intermaxillary bone, there is no urgency for the performance of an operation, as the closure of the labial cleft alone would be of little advantage in the feeding; but even in this case the lip should be operated on, the child being well, long before the end of the first year. Often the intermaxillary bone, firmly connected with one side of the hard-palate, is so much twisted forwards and outwards that it offers a serious impediment to the success of the operation upon the lip. In these circumstances the projection must be forced back into the intermaxillary gap some days, at least, before the lip is dealt with. The twist may be given to the bone by a strong pair of sequestrum-forceps, the blades of which have been carefully surrounded with lint, so that their pressure may not injure the bone or the mucous membrane. During the subsequent day or two a piece of adhesive plaster secured along the lip will suffice to steady the repressed bone. If the intermaxillary projection be associated with a bilateral fissure of the front of the palate, it may be far advanced upon the nasal septum, to which it is attached posteriorly. It will then be advisable to remove a triangular segment from the septum, by means of strong scissors or cutting pliers, before the repression of the mass is proceeded with. Sometimes one is greatly tempted to remove the intermaxillary bone altogether; but as it will prove very useful in filling the front of the palatine cleft, every effort should be made to get it back. Its removal would certainly be followed by a falling back of the upper lip. Moreover, in it are the germs of the central incisor teeth, and perhaps, also, of one of the lateral incisors in addition. When all local disturbance has quieted down, after the thrusting back of the mass, the lip may be dealt with on the principles described above.

If the intermaxillary bone be found eventually to be useless, or possibly an impediment to the closure of the cleft, it can at any time be taken away; but it should always have every chance given it. If the incisor teeth come through horizontally or obliquely, and the dental surgeon do not succeed in imparting to them a right direction, they must be extracted. When, as sometimes, though rarely, happens, the intermaxillary bone is advanced to the utmost, and attached to the tip of the nose, it must, probably, be sacrificed; but even then the median piece of the lip which partially covers it should be turned down to form a greatly-wanted columna for the nostrils.

If, after even the most careful operation, the promises of a satisfactory result end in suppuration and disappointment, all hope need not be laid aside. Attention must be given to the child's health, and still stricter inquiries be made into the condition of drains, sinks, and closets; the raw surfaces must still be brought and kept together by adhesive plaster, and, later on, feeble granulations stimulated and improved by judicious scraping. Thus it may be possible to secure an excellent result after all; and a year or two later any unnecessary and unsightly scarring may perhaps be lessened by operation.

Edmund Owen.

HEAD-INJURIES, Diagnosis of.—However trifling an injury to the head may appear, it ought never to be lightly regarded. The importance attached to such lesions is not so much due to the mere implication of the scalp and skull, as to the degree in which the brain and its membranes are involved. They ought to be estimated primarily according to the amount of extracranial injury, and, secondarily, as to the probability of the brain and its membranes becoming affected. Without any primary or secondary implication of the brain or its membranes, a fracture of the skull, even when compound, is of much less importance than a simple cerebral contusion or laceration. Owing to the intimate anatomical relations existing between the external and internal parts of the head, amounting in some parts to direct continuity of structure, inflammatory action is apt to spread from the former to the latter. So, a small scalp wound becoming affected with inflammation may lead to a fatal issue. Primary symptoms cannot be relied on as a sure sign of the amount of cerebral injury, as in many cases ultimately proving fatal the primary indications are extremely slight, or completely absent. In other instances, the symptoms may be very alarming at the outset and may yet pass rapidly away, the patient remaining in good health afterwards. A case which came under the writer's observation aptly illustrates the former of these statements. A man received a blow on the head while at his employment. He considered it a trifle, and continued at his work for three days without complaint or reference to his injury. But on the fourth day he was rather suddenly seized with symptoms of compression, from which he died. The post-mortem examination showed a large clot of blood over the posterior aspect of the left hemisphere. There were no inflammatory products.

Although, as a rule, the probable amount of injury sustained may be estimated by the degree and kind of violence used—and information on this point is of great value—still it cannot be too implicitly relied on, as comparatively slight violence has at times produced serious lesions. A blow on the head with the naked fist would not be expected to produce a fracture of the skull accompanied by a serious brain-lesion; but such a thing has occurred. A man received a blow on the eye from a comrade. He neither fell, nor was his head driven against any object whereby the effect of the blow might have been increased. Yet that man sustained a fracture of the orbital plate of the frontal bone, with laceration and extravasation of blood into the corresponding frontal lobe, from which he died. The history of the accident may serve to indicate whether the lesion produced is likely to be diffuse or local. A fall upon the head or a blow from a heavy weight is likely to be followed by a widespread injury; while a local lesion is most likely to be produced by a blow from a pointed instrument. It must not be overlooked that the presence of constitutional disease will materially affect the prognosis in any traumatic lesion of the skull or its contents. Thus such an injury to the head as might be readily recovered from by one in good health, would not improbably induce serious or fatal results in one suffering from Bright's disease, through the occurrence of secondary inflammation or its consequences. In certain cases of cerebral tumours, the first indication of their presence has followed upon slight injuries of the head, and the symptoms of the disease have been mistaken for those of the injury.

Though the brain is spoken of as a single organ, it is made up of a series of centres, each with definite functions. Physiologically it may be divided into motor and non-motor areas, the latter including the portions of the cerebrum situated in front of, below, and behind the motor area.

All are agreed in regarding the ascending frontal and parietal convolutions along with the paracentral lobule as the chief motor centres. Some are inclined to limit the motor area to these, since they are the parts which have been most clearly demonstrated in man as regulating the motor functions. Those who argue from physiological investigations on the lower animals include, along with the above-mentioned areas, the bases of the three frontal convolutions and the postero-parietal lobule. There is still considerable diversity of opinion as to the particular spots in those areas to which the special motor functions ought to be relegated. To some extent this may be accounted for by the fact that the data have been derived from different sources—in man from clinical and pathological observations, in the lower animals from direct physiological experiment. As might be expected, the conclusions of the latter are the more advanced and more minute. But even from the side of experimental physiology all observers are not quite at one. A few of the main points may be here briefly alluded to.

Charcot and Pitres place the centre for the motor power of the arm in the middle of the ascending convolutions, and especially in the middle third of the ascending frontal. Hitzig and Ferrier concur in placing the centre for these movements in the upper part of the ascending frontal.

The centre for the motor power of the lower limbs, according to Charcot and Pitres, is in the paracentral lobule. Ferrier places it in the postero-parietal lobule; while Hitzig locates it in the ascending frontal, immediately below the centre for the movements of the arm. Charcot in this localisation agrees more nearly with Ferrier than with Hitzig.

Among the associated monoplegias, Charcot and Pitres attribute those of the arm and face to lesions of the inferior half of the ascending convolutions; those of the face and tongue to very limited lesions of the inferior extremities of the ascending convolutions, especially that of the frontal; and those of the arm and leg to lesions in the superior half of the ascending convolutions. Ferrier goes further and localises other centres of movement as follows—of the hand and wrist, in the ascending parietal; of the facial muscles, in the middle third of the ascending frontal (Hitzig agreeing in this) and in the base of the second frontal; of the mouth and tongue, in the lower third of the ascending frontal and in the base of the third frontal (the former portion agreeing with the conclusions of Charcot and Pitres); of the lateral movements of the head and eyes, in the posterior third of the first frontal and the corresponding part of the second frontal.

Ferrier defines the sensory zone in monkeys as that portion of the cerebrum which lies posterior to the motor zone. In man it may be said to lie below as well as behind the motor zone. In it the centres of sight, hearing, touch, smell, and taste are situated. He particularises as follows. The sight centre is located in the angular gyrus, and embraces also the adjoining part of the occipital lobe. The centre for hearing is seated in the superior temporo-sphenoidal convolution. The tactile centre is in the hippocampal region; while the centres for smell and taste are situated together at the lower part of the temporo-sphenoidal lobe.

If the lesion of any of these centres in the sensory area be unilateral, its fellow in the opposite hemisphere appears to take on the whole function. As far as being aids to the localisation of lesions, it is unfortunate that it is only when there is an identical bilateral lesion that the special sensation involved becomes completely and permanently impaired; therefore unilateral lesions in these areas cannot be recognised by loss of function, and on this account they are apt to remain latent. In destructive lesions of the posterior third of the internal capsule, external to the optic thalamus, hemianæsthesia of the opposite side of the body results.

The portions of the brain in front of the motor area, including the orbital lobe, are not known to be connected with any definite function, except it be that of ideation; and as the one side of the brain is capable of continuing this function after the other side has been destroyed, it is difficult to find any definite symptom indicative of a unilateral destructive lesion in this region.

Lesions of the posterior portion of the third frontal convolution, Broca's region, cause defect in articulate language; when these lesions are destructive they usually produce a distinct psychological disorder, and when they are left-sided aphasia almost always results. When they are unilateral, there is no paralysis of the muscles concerned in articulation, but when destructive lesions in this area are bilateral there is both aphasia and paralysis of the tongue and mouth.

According to Charcot, all paralyses arising from destructive lesions of the motor cortex are permanent, and after a certain time are accompanied by secondary contractions of the paralysed muscles and descending degenerations of the motor tracts. The loss of motion is most marked in those movements which are most independent, the arm being more paralysed than the leg. If a unilateral destructive lesion of the brain involve the whole motor cortex, complete permanent hemiplegia of the opposite side of the body would result. Permanent monoplegia is produced by limited lesions of the cortex of this area. Cortical hemiplegia is not accompanied by defective sensation; whereas hemiplegia due to lesion in or near the corpus striatum is generally associated with a degree of anæsthesia, which, however, is of short duration. As distinguishing features of paralysis arising from intra-cranial lesions, the nutrition and the electrical contractility of the muscles are not affected. They may, however, suffer from disuse, and they may become rigid and contracted through secondary changes or extension of the disease to the spinal cord.

In a case of hemiplegia, the surgeon should first make out if it arises from a cerebral lesion. In the early stage, paralysis of cranial nerves and the presence of mental disturbance will in most cases point to this conclusion. Somewhat later, in the possible absence of these indications, assistance may be derived by noting if the nutrition of the muscles is fairly well preserved, and if they contract to electricity. Secondly, let him ascertain whether the paralysis is permanent, by the muscles tending to assume secondary contractions—from descending degeneration of motor strands—if so, if it be cortical, the lesion will be situated in the motor area of the opposite hemisphere. If the paralysis is confined to certain groups of muscles, the seat of the lesion in a particular motor area can be diagnosed. When right-sided hemiplegia is associated with aphasia, the lesion will include the posterior part of the third frontal convolution.

Irritative cortical motor lesions may give rise to epileptiform convulsions, which begin with a motor aura, and are either general or confined to one half of the body (hemispasm), or to a single muscular group (monospasm). If the lesion is in the motor zone, paralysis of the affected muscles is apt to ensue, and this may be also a guide to the area affected. In general, the lesions capable of provoking epileptiform convulsions are seated in the vicinity of the cortex, and the parts convulsed at the beginning of the attack (protospasm) may be taken as a guide to the lesion. There are, however, instances in which limited convulsions have been present during a considerable period prior to death, and where, judging from these, cortical lesions were expected to be found in the motor area and yet none were discovered; so that it must be admitted that there are a few cases, where functional disorder may induce symptoms similar to those of organic disease.

It will thus be seen that in morbid states of the brain there are two problems to solve, the locality and extent of the part affected, and the nature of the lesion, or, in other words, regional and pathological diagnosis. Regarding the former, the symptoms of cortical lesions, whether they be the result of injury or disease, depend on their situation and on whether they are unilateral or bilateral; so that a knowledge of the physiology of the cerebrum, and especially of the motor centres, becomes a necessity; and if the surgeon is to profit by this, he must know the exact relation in which the various parts of the brain stand to the outside of the head.

Whatever form the pathological lesions assume, they may be divided broadly into two classes, irritative and destructive. The former, among other causes, may be induced by depressed fractures, spicula of bone driven into the brain or its membranes, thickening of the membranes, &c. These may cause twitchings and convulsions of groups of muscles or of one limb, without loss of consciousness; or of the whole of one side, which is usually accompanied by loss of consciousness. Primary paralysis generally indicates a destructive lesion, such as laceration of the brain or infiltration of blood into the brain-tissue.

A few indications may here be given of the relations of the external parts of the head to the convolutions and sulci of the cerebrum. The base of the brain is on a higher level in front than behind. The base of the anterior lobes corresponds to a line drawn across the forehead at the level of the eyebrows. At the side, the base may be roughly indicated by a line drawn from a point (in the adult) half an inch above the external angular process of the frontal bone to the upper part of the external auditory meatus, and from that to the occipital protuberance, the cerebellum lying below that line. To find the fissure of Sylvius (in the adult), draw a line from a point one inch and a quarter behind the external angular process of the frontal to a point three quarters of an inch below the most prominent part of the parietal eminence. The main fissure is seated in the first three-quarters of an inch of this line; the remainder of the line indicates the horizontal limb; while the ascending limb runs vertically upwards from a point two inches behind and slightly above the external angular process. To find the fissure of Rolando, draw two perpendicular lines parallel to one another from the longitudinal fissure—the first to the depression in front of the external auditory meatus, the second to the posterior border of the mastoid process. These lines will give approximately the anterior and posterior limits of the fissure of Rolando, its lower extremity being bounded by the fissure of Sylvius. The point where the anterior line crosses the fissure of Sylvius will be about the anterior inferior extremity; while the posterior superior extremity will correspond to the part where the posterior line meets the longitudinal fissure. The ascending frontal and parietal convolutions bound this fissure.

Scalp wounds are not in themselves dangerous. They heal with ordinary care quite as well as wounds do in any other part of the body, and the reason why they ought to be more carefully examined and treated is, as has been above indicated, on account of their relation to the cranial contents. Such wounds permit of an accurate examination being made of the state of the skull after injury. In all scalp wounds, when the existence of fracture is suspected, a digital examination should be made; if at all possible it is much preferable to the probe. When the wound is large the eye may enable one to diagnose with more precision. When, however, the fracture is not compound, other signs are required for the determination of its existence. There are three external phenomena which are of diagnostic value in cases of supposed fracture of the skull. These are: 1st, infiltration of blood into the tissues in certain directions and places; 2nd, the escape of the cranial contents—blood, cerebro-spinal fluid, and brain-matter; 3rd, symptoms and appearances of brain-lesions complicating the fracture.

A *hæmatoma* may form over a depressed fracture, and prevent its recognition by masking its external physical signs. Again, consequent upon a blow, there may be a rupture of the tissues and an infiltration of them with blood, and, as this condition occasionally assumes the form of an elevated ridge with a hollow in the centre, it might be mistaken for depressed bone. In the former, if there were reason to suspect the existence of a fracture from the symptoms, an antiseptic incision would reveal the true state of affairs. In the latter, firm pressure with the finger on a portion of the elevated border would dispel the swelling at that point, and reduce it to the level of the surrounding scalp.

With *infiltration of blood* into the eyelids, causing discoloration, a differentiation requires to be made between fracture of the base in the frontal region and the ordinary 'black eye.' A pathognomonic distinction cannot be made, as is sometimes stated, by the shade of colour, as the colours in the two cases are sometimes identical. In 'black eye' the eyelids swell first, and the conjunctiva is only afterwards affected, and often not at all. When the blow has been very severe there is great difficulty in separating the eyelids, and often in such cases, as seen a few hours after the injury, there may be no conjunctival ecchymosis. In infiltration from fracture of the orbital plate of the frontal, the eyeball becomes more or less prominent and fixed. The conjunctiva is generally first affected, or it may become so synchronously with the lower eyelid, which assumes a baggy appearance, much like what is seen in œdema, with the additional discoloration. The infiltration may go no further than the lower eyelid, or it may involve the upper eyelid to a slight degree. In cases of wounds of the brow, a discoloured infiltration into the eyelids is very apt to ensue. This always affects the upper eyelids first, then spreads to the lower. Seldom is the conjunctiva infiltrated in such cases, and only so when the pericranium has been separated. But when the fracture runs through the orbital ridge, then the appearances very closely resemble those of 'black eye.' Ecchymosis frequently shows itself behind the ears and extends down the neck in fractures of the base, and when it appears twenty-four or more hours after the injury it is all the more likely to be indicative of this form of fracture. In the pharynx infiltration of blood is likewise occasionally seen in fracture of the base.

Bleeding from the ears, the nose, or the mouth, after an injury to the head, is a common accompaniment of fracture of the base; and when one or other of these follows an injury to the head alone, the source of the bleeding ought to be closely investigated. After an injury to the head, when bleeding takes place from a previously healthy ear in a continuous flow, lasting for an hour or more, in all probability there is fracture of the middle fossa, with rupture of the membrane of the tympanum. If this be followed by a more or less continuous stream of clear fluid, the probability of fractured base is increased; and if these be closely succeeded or accompanied by facial paralysis on the same side, the diagnosis of basal fracture of the middle fossa is positive. Bleeding from the mouth may occur from a fractured base in one of three ways—through the Eustachian tube, through the posterior portion of the roof of the nose, and through a ruptured pharynx, communicating with the fracture—a very uncommon occurrence. The blood in such instances might be swallowed, and escape observation until afterwards vomited. Bleeding from the mouth is by no means such a common accompaniment of fracture of the base as bleeding from the ear, and unless when clearly traceable to one of the abovementioned sources, it is of no value as a diagnostic sign. When it is suspected that it proceeds from a fracture of the base, the pharynx ought to be closely examined. If the hæmorrhage proceeds from a rupture of the mucous membrane of the pharynx, the result of indirect violence, the probability is that there is a fracture of the base of the skull. If there be no rupture of the mucous membrane of the pharynx, then the channel for the blood is limited to the Eustachian tube or the roof of the nose. When the blood comes by way of the Eustachian tube, an examination of the ear on the injured side will reveal a dark, distended, tympanic membrane from the presence of blood within. Blood will likewise trickle through the Eustachian catheter when introduced into the tube.

Hæmorrhage passing into the mouth, from the upper and back part of the nostril, may be considered along with bleeding from the nose. In some cases of fracture of the nasal bones severe bleeding from the nose comes on; but, as a rule, firm pressure exercised by the fingers on the part for five consecutive minutes will arrest it. When the nasal bones have been driven through the cribriform plate of the ethmoid, or when this plate has been otherwise shattered and driven in, and the anterior extremity of the longitudinal sinus has been opened, the bleeding from the nose is venous and much more profuse. On one occasion the writer saw such a case, where the bleeding was not at first very profuse, but this stage was followed by a sudden burst —probably on the removal of a clot—when the venous blood rushed like a torrent from both nostrils for nearly a minute. This is a rare occurrence. The bleeding, however, in shattering of the ethmoid is generally copious, and continues for a considerable period.

Cerebro-spinal fluid may escape through any openings by which blood finds its way from the interior of the skull to the outside. Its escape shows that not only is there a fracture of the skull itself, but also that there is laceration of the brain-membranes. The most frequent point at which this laceration takes place is the tubular prolongation of the membranes surrounding the seventh pair of nerves. It escapes in lesions of the vertex, as well as in those of the base, though in the former the amount is small if the head be kept elevated and the patient at rest. If, on the other hand, the patient be permitted to toss about, to depress the head, or to make violent expiratory efforts, the fluid wells freely away. After an injury to the head, when a clear fluid flows continuously from the ear, especially after a preliminary bleeding, it is almost certain to be cerebro-spinal. The same may be said of the clear fluid that escapes from compound fractures of the skull. When a clear liquid proceeds from the nose or mouth it cannot be satisfactorily traced to a fracture of the skull except by chemical examination, which can be easily carried out. The cerebro-spinal fluid is limpid, contains little or no albumen, and a large quantity of chloride of sodium.

The escape of brain-matter from any of the cavities leaves no doubt as to the nature of the injury—fracture of the skull, with laceration of the brain tissue. Brain-matter frequently escapes from compound fractures in which portions of the bone have been driven into its substance. It has in a few cases escaped from the ear, and also from the nose.

The effects of severe injuries to the head, with or without fracture of the skull, on the *mental condition* is very diverse; the patient may be in a state of profound coma, or in one of complete consciousness, in which a careful examination detects nothing wrong mentally. Though this be true, it is uncommon to find no mental peculiarity in severe head-injuries; and even in cases in which replies are given rightly enough, there is often a cloud hanging over the intelligence, as indicated by the expression of the face, and the tardiness of the answers to the simplest questions. The mental derangement, though at first indicating but slight disturbance, generally increases after the lapse of an interval varying from a few hours to as many days.

There are some cases of fracture of the skull in which no external physical signs exist, but which may be detected from the symptoms to which they give rise. There are, no doubt, many instances of fissured fracture which are free from either symptoms or appearances which would enable the surgeon to pronounce a definite opinion as to their presence. In fracture of the base, besides what has already been mentioned, reliance must be placed upon a careful study of the appearances and phenomena exhibited, all of which are fully entered into under the heading of Skull, Fracture of the.

Patients are brought under the surgeon's notice who are absolutely insensible, and in such cases it is necessary to make at least a proximate diagnosis between pressure on the brain and insensibility induced by drugs or alcohol. No doubt the history in many instances of this kind is amply sufficient to point to a definite cause for the condition; but in many others it is misleading, and in not a few there are—at least in that stage when it is most important that a diagnosis should be made—no items of previous history obtainable. Under such circumstances one requires to rely on the symptoms. In opium-poisoning, as well as in certain cases of traumatic or idiopathic pressure on the brain, the pupils are contracted and fixed; and if reliance were placed on the condition of the pupils alone, the one state might be mistaken for the other. In opium-poisoning, one is almost sure to obtain probable evidence that opium has been taken from the laudanum phial or pill-box found in possession of the individual or in his immediate vicinity. When the patient has taken solid opium there is seldom any distinctive odour from the breath. When laudanum has been drunk, its peculiar odour is usually perceived at an early period in the case, though after the first few hours it is frequently absent. In any case, its absence must not count for much in a diagnostic point of view. When the coma of opium-poisoning has set in, it is accompanied by a slow, irregular, intermitting cardiac and respiratory action, which are not readily mistaken by those who have had experience of them. In such cases there is seldom any injury to the head, as would most likely be the case were the symptoms due to traumatic compression.

Alcoholic coma may be, and very frequently is, accompanied by wounds or bruises on the head. The coma (not mere drunkenness) arising from alcohol may be distinguished from that due to other affections by the fact that, when the patient is left undisturbed for twenty minutes, the pupils are contracted to the size of a pin's head. If an attempt be made to rouse him, by shaking him or pulling his hair, though he still remains quite comatose, his pupils will slowly dilate, until, if the physical stimulation be continued, they become fully dilated. If the patient be then left undisturbed, the pupils remain dilated for a period of variable duration, after which they begin to contract, though at a very slow rate, until they reach their former dimensions. The time taken for the transition from the fully-dilated stage to that of pin-head contraction is from ten to twenty minutes, varying according to the intensity of the coma. In rare cases, where the coma is very intense, the change has been completed in five minutes. In instances in which the patient is not deeply comatose, the dilatation continues for ten minutes, and then the contraction sets in at a very sluggish rate. In persons in whom the alcoholic coma is passing off, and who can be temporarily roused, the dilatation, once effected, continues, or the pupil may become smaller, though it does not attain the same degree of contraction as it formerly did. In some uncommon cases of cerebral compression the contracted pupil will slightly enlarge on stimulation (not fully dilate, as in alcohol), and almost immediately thereafter contract to its former condition. On very rare occasions, when the alcoholic coma is about to have a fatal issue, shortly before death the pupils become widely dilated.

Some have supposed that the state of the patient's temperature yielded a means of diagnosis, but it is not of the slightest value in practice, and, if trusted to, would be sure to mislead. William Macewen.

HEARING, Disorders of. *See* Deafness, Diagnosis of.

HEART, Rupture and Wounds of the.—Rupture of the heart is generally caused by severe compression of the thorax from some heavy body passing over it. It is not infrequently accompanied by rupture of the valves. Death takes place nearly always directly after such an accident, either from the shock to the system, or from blood entering the pericardium freely, and thus interfering with the heart's action.

Wounds of the heart may result either from an external penetrating agent, or from a fractured rib or sternum. The latter, however, does not take place so frequently as the similar accident in the case of the lung, owing to the better protection of the pericardiac cavity in the chest. Its consequences, on the other hand, are much more serious, and for all practical purposes wounds of the heart, whether produced by an external penetrating agent or by fractured bone, may be considered together.

These wounds are generally regarded as necessarily fatal, and though a large proportion of them are no doubt so, yet recovery takes place in about 15 per cent. As in rupture of the heart, death takes place either *immediately* from shock or from blood entering the pericardium and so impeding the contraction of the muscular fibres, or *secondarily* from the after-consequences of the wound. Thus death may take place from continued hæmorrhage either externally or into the surrounding tissue. Or it may take place as a result of the acute pericarditis and myocarditis set up by the injury.

The nature of the wound does not appear materially to affect the mortality, nor does the part of the heart wounded. Thus the average of fatality remains nearly equally distributed amongst punctured, incised, and lacerated wounds, and the same is true whether the right or left ventricle or the right or left auricle be wounded.

The *signs* of a wound of the heart are the fact of a wound existing in its immediate neighbourhood, the occurrence of external hæmorrhage taking place from it, and the signs of internal hæmorrhage, which may take place either into the pericardium or into one of the mediastina. The pulse is small, intermittent, and irregular. There is often considerable pain over the sternum, and much dyspnœa, though these are not constant. The dyspnœa does not come on immediately, but is generally a later sign in those who live sufficiently long. Auscultation may reveal a friction sound if the amount of blood in the pericardium be small, but more frequently nothing is audible, the heart-sounds being muffled by the surrounding blood.

Treatment.—Rest to the injured part, so far as Nature herself permits it, is the most important element in the treatment of these cases. This is necessary for the prevention of hæmorrhage, both internal and external. The patient should lie absolutely still in the position most easy to him, no food or stimulant be allowed for the first twenty-four hours, and after that only the very smallest quantity of fluid nourishment. Half a pint of milk, with a very small allowance of ice to suck, is generally all that is required for three or four days after the injury. Small venesections may be employed with advantage, during the first few days, to diminish the tendency to hæmorrhage and to increase the coagulability of the blood, if they can be done without too much disturbing the patient. Cold may be usefully applied to the part, and it is said that belladonna and digitalis administered internally have also a certain value. Much trust, however, cannot be given to these drugs, and it is probable that rest, starvation, and small bleedings have a much more powerful influence for good than any drug. H. G. Howse.

HECTIC FEVER is the systemic expression of a continuous wasting or exhausting process, which in surgical experience is so frequently suppurative that the common term 'suppurative fever,' though too restrictive, is hardly a misnomer.

Pathology. — Unlike traumatic and many other fevers, hectic is not produced by absorption into the blood of any morbid matters. It may be due to a pre-existent state of over-action and excitement, sufficiently intense and prolonged to have greatly depressed the vital powers; to defect of the nutrient powers, preventing due repair of the blood; or to continued subtraction from that blood of its protein elements, through some disordered excretion, or by means of suppuration. Thus, acute exhaustion, as from nervous shock or hæmorrhage, is expressed by prostration, chronic exhaustion by hectic. Therefore the names of all the diseases that frequently give rise to this fever may be omitted here, if it be taken that all subacute or chronic maladies, attended by pain, sleeplessness, inedia, impairment of the assimilative functions, loss by the kidneys of albumen or sugar, &c., are generally accompanied or closely followed by hectic. But the most frequent and common cause is prolonged suppuration; therefore, as strumous and tuberculous diseases are those which most frequently induce such discharges, and as persons of such diatheses are usually feeble—in other words have little recuperative power—so do we find hectic very surely developed in strumous and tuberculous affections accompanied by pus-formation.

Symptoms.—Since the morbid action which induces hectic operates little by little throughout a considerable period, so must the advent of that fever be very gradual, its first onset very slightly marked. Probably a sense of fatigue and weakness on first waking, a distaste for the morning meal, a rather rapid and small pulse, are the first signs. Afterwards, a slight loss of flesh will be noticeable, and the pulse becomes irritable; that is to say, while the patient is at rest its rapidity is normal or nearly so, but any excitement or exertion raises it by ten or twenty beats. The skin is somewhat dry and hot; this is at first only observed in the evening. Afterwards it is dry throughout the day, the evening, however, still keeping its pre-eminence. Many patients are at that time chilly, uncomfortable, and often thirsty; the tongue is either white, slightly furred, and feels sticky in the mouth, or else is unnaturally red and irritable-looking. The rest, at all events during the early part of the night, is unbroken; but awakening takes place early, and the patient finds his night-dress and the bed-clothes wet with perspiration.

By this time the febrile state is fairly established; the emaciation has become pretty strongly marked; the face, frequently pale and transparent-looking, flushes very easily, or there is a permanent, sharply-defined flush about the cheeks, the rest being pallid; the redness of the lips is often strongly marked, the eyes are bright, the sclerotic brilliantly white. Morning fatigue and languor, with evening irritability and excitement, correspond with the thermograph, which shows a normal, or even subnormal, temperature in the early hours, and a rapid rise after 2 p.m. Such is the usual and general course, but occasionally variations occur, probably produced by some condition of the digestive system. At this time the tongue is usually very clean, presenting a lighter or more pink-like red than is normal. The appetite is very variable and capricious; sometimes the patient eats well, at other times but little; requires much tempting, and often, after selecting certain viands for his next meal, turns from them, when set before him, with disgust. The action of the bowels is likewise irregular, the stools often loose, though not large in amount; at other times constipated. The urine is pale, rather abundant, and deposits much lithate of ammonia; there is, too, some excess of sulphuric acid and chloride of sodium.

If the exhaustive process and, therefore, the fever still continues, the last stages are marked by obstinate diarrhœa and violent night-sweating, called 'colliquative,' while in the day the excessive dryness of the skin renders it rough and furfuraceous. Emaciation is extreme. The joints of the limbs come to be larger than the mid part of each segment. On the trunk the bony processes become sharp and prominent; the skin over them, tightly stretched, is especially liable to develop bed-sores. The pulse is very small and quick, from 120 upwards; the temperature, while still subject to periodic elevations, has a tendency in the intervals to fall below normal. In this stage certain viscera may enlarge—the liver more particularly, and the spleen—while the urine exhibits casts called hyaline. If these conditions arise, the skin assumes an earthy hue, hardly icteroid, even though the liver be much involved. These symptoms mark lardaceous disease, which is chiefly, if not entirely, associated with prolonged suppuration. Throughout, the mind remains clear, and, until death is very near, free from delirium, which is often absent altogether; although in all stages, save the earliest, the patient is not infrequently troubled by unpleasant, even frightful, dreams, from which he awakes somewhat confused.

Treatment.—The chief, most certain and rapid cure of hectic is removal of its cause, either by healing a discharging sore or cavity, or by ablation of diseased parts. The surgeon, though he may often have witnessed such an effect, is always charmed to see how, after a successful operation, his patient rallies from even severe hectic. The writer has more than once witnessed this result when lardaceous disease was already somewhat advanced.

The draining, and if possible, healing of an abscess, the removal of sequestra, though perhaps large and deep, should never be neglected. More important operations, especially such as mutilate to a greater or smaller extent, viz. excision of a joint or amputation, though never to be inconsiderately undertaken, must not be evaded until too late. In many cases the position of the disease permits of no such measures, and of these there are two sorts: such as may get well if life can be prolonged and strength maintained, and such as must prove, in an uncertain period, fatal. The treatment, though the same in both, is evidently more important in the former case. The surgeon's object must be to maintain strength, and so lessen fever. Food should be of the most nutritious forms, administered frequently and in small quantities, nor should it be at any time intermitted for any long period. Stimulants, in moderate quantities, are generally necessary. To diminish the fever, quinine in doses of from 3 to 10 grains, may be given an hour before the periodic rise. Kairine is in many cases useful. Sulphuric acid and iron are also valuable. If these check the fever they will also diminish the night-sweats, and for this latter purpose belladonna or its alkaloid is often effectual, as also is sponging the surface with hot vinegar and water. When diarrhœa supervenes, such astringents as kino or sulphuric acid, with spirits of chloroform, cardamoms, and tincture of opium, may be administered. The latter drug may only be used in small doses, as it augments perspiration. By such means we may, in the former class of case above-mentioned, prolong life until the local disease heals, or at all events we can carry out our duty of maintaining existence as long as possible.

R. Barwell.

HEMERALOPIA.—This term, like nyctalopia, has been, and still is, used in two opposite and contradictory senses. Some writers employ it to denote *day*-blindness, and others *night*-blindness. Most modern authors use it in the latter sense; all older writers in the former sense, and in contradistinction to nyctalopia. As Galen, in his Hippocratic lexicon, defines 'nyctalopes' to be those who are blind at night, it is certain that the original meaning of the word hemeralopia was day-*blindness*, and, so far as the term is admissible into modern nomenclature, it should continue to be used in this sense. Day-blindness usually assumes the form of photophobia, or dread of light, and is commonly dependent upon inflammation of the cornea, sclerotic, or iris. See *Nyctalopia*, under Amblyopia. J. Tweedy.

HEMIANOPSIA denotes an absence of one-half of the visual field. It is also called hemiopia. *See* Amblyopia; Perimetry.

HEMIOPIA. *See* Hemianopsia.

HERNIA of the BLADDER. *See* Cystocele.

HERNIA CEREBRI. *See* Brain, Hernia of the.

HERNIA, Inflamed.—In the form of rupture so named, there is acute or subacute inflammation of the interior of the hernial sac, and of its contents. The condition, indeed, is essentially that of acute peritonitis, limited to the parts concerned in the protrusion. The following are among the chief causes of this condition:—The pressure of an ill-fitting truss, blows upon the part, violent exercise, the arrest of a foreign body in the herniated loop, severe diarrhœa. The condition is much more common in irreducible than in reducible herniæ, and in small ruptures than in large. It is especially apt to occur in herniæ containing omentum. Omentum appears to be more readily inflamed than gut, and its lack of elasticity renders it less able to withstand the effects of violence.

The commonest seat of an inflamed hernia is a small irreducible femoral epiplocele. On examination, the inflamed parts are found to be red and œdematous. The sac will probably contain no fluid, but on the surface of the inflamed serous membrane will be many flakes of lymph. In some cases, however, there is much serous fluid in the sac, and but little lymph upon the surface of the membrane. The condition may pass on to suppuration, and the sac may be converted into an abscess-cavity. As a rule the mischief ends in resolution, and the involved gut or omentum, if not already irreducible, is found to have become fixed to the sac by unyielding adhesions.

The *symptoms* in this form of hernia are tolerably pronounced. The tumour is irreducible, is tense, hard, and firm, is the seat of much pain, and is extremely tender. If situated in the groin, the pain is increased by movement of the limb. The skin over the swelling is hot, red, and œdematous. The tumour is most probably dull on percussion, but still retains an impulse on coughing. There is some malaise, and a varying degree of fever. There will probably be nausea and possibly vomiting, but in any case the latter symptom will be slight. There may be constipation, but it will, if present, not be absolute. There is no marked abdominal pain, and no constitutional depression.

As a rule, the case ends favourably in three or four days, but in exceptional instances the inflammation may spread to the general peritoneal membrane, or the gut may become acutely inflamed and even gangrenous, and extensive suppuration may appear in the sac.

In the *treatment* of the case, absolute rest in bed must first be insisted on. The parts should be so adjusted by posture as to relax as far as possible the tissues about the hernia. An ice-bag should be applied to the part, or a proper degree of cold may be maintained by Leiter's tubes. Opium should be given, and the patient placed upon a scanty diet of fluid nourishment only.

If any of the complications arise to which reference has been made, they must be treated in the usual way.

Frederick Treves.

HERNIA, Irreducible, is a morbid condition of a hernia in which the contents of the sac cannot be completely replaced within the abdomen. This form may include intestine or omentum, alone or both together. This condition does not give rise to symptoms of strangulation or of obstruction, although it frequently causes increased dyspeptic flatulence. It is due occasionally to non-recognition of the lesion, more frequently to neglect on the patient's part to procure a well-fitting truss.

Irreducibility may depend upon causes situated—(*a*) outside the sac, due to the fibrous structures of the abdominal walls; (*b*) in the sac itself, as seen in cases where the neck is much narrowed or unduly thickened; or (*c*) in the very large majority of instances it is referable to altered conditions of the sac-contents. These are the presence of fluid, more or less in amount, in the sac, so that no well-directed pressure by taxis can be exerted upon the solid contents; adhesions between the omentum or the intestine and the sac; fibrous adhesions uniting contiguous portions of the omentum, so that it cannot be unravelled; adhesion of a coil of intestine; adhesions between omentum and intestine; accumulation of fat, or fibroid changes taking place in the omentum; hypertrophy of the mesentery; sudden descent of a large amount of intestine or omentum, or both together; fibrous bands passing across the sac; and, lastly, the anatomical peculiarities of the extruded viscera, which either have no sac at all, or only an incomplete one, as in hernia of the cæcum, sigmoid flexure, bladder, &c.

Irreducible herniæ are most commonly met with in the inguinal, femoral, and umbilical varieties.

In the inguinal variety of hernia, 2·8 per cent. are irreducible in males, and in females 3·1 per cent. In the femoral variety, the protrusion is irreducible in males to the extent of 15·5 per cent., and in females to that of 25·2 per cent. In both varieties of hernia, the right side is that on which it is most commonly irreducible. In females, this holds good positively and relatively; in males, hernia of the left side shows, in later life, a slightly increased tendency to become irreducible.

The contents of irreducible herniæ are usually omentum, the intestine being rarely irreducible; so that irreducible intestine amounts in inguinal herniæ to only 1·6 per cent., and in femoral herniæ to ·3 per cent. of all cases of irreducible hernia. This condition of hernia is liable to become inflamed, incarcerated, or strangulated; and cases have also been described in which the irreducible intestine has been ruptured by blows and falls.

The *symptoms* of irreducible hernia are those referable to ruptures generally, only largely increased. Beyond these symptoms are those of colic, constipation, and inconvenience from the size and weight of the hernia. There is no limit to the size which irreducible herniæ may attain, varying as they do from that of a small walnut to one involving a large part of the intestines and omentum.

As irreducible hernia leads, apart from local inconvenience and dyspepsia, to more serious morbid conditions, its treatment should be carefully watched. In all cases instrumental support must be given, not only to procure reduction of the mass if possible, but also to prevent increase of the hernia and its consequent dangers. In the majority of cases, complete reduction may be looked for by the application of well-fitting trusses, assisted by the cordial co-operation of the patients. By the constant pressure of hollow-padded trusses, gradual absorption of the omental fat and adhesions is effected, so that after wearing instruments for a longer or shorter time the mass becomes so diminished in bulk that it can be easily reduced. This reduction may take place gradually or suddenly.

If the presence of fluid in the sac be the cause of irreducibility, this may be evacuated by tapping, when the contents are in some cases capable of reduction.

Irreducible omentum may be removed by operation, and at the same time the sac should be excised. This operation is not without danger, for several fatal results have been recorded.

Irreducible intestine should be treated by suspensory bags, or by hollow-padded trusses having rim plates, the interval being filled in with chamois leather, so as to increase their depth without increasing their weight.

Herniæ of the bladder or large intestine, which, by the nature of their anatomical relations, are frequently irreducible, must be treated by palliative measures of support, by strong suspensory bags, or hollow-padded trusses with rim plates. *See* Trusses.

The plan of attempting reduction of old irreducible hernia by long confinement to bed and restricted diet, so as to lessen the amount of fat in the omentum or mesentery, has been recommended. The application of ice is sometimes followed by reduction, the result as much of the steady, persistent pressure of the ice as of the physiological effects of cold.

John Langton.

HERNIA, Obstructed or Incarcerated. In this form of rupture there is a hindrance to the return of the bowel into the abdomen, and an obstacle to the passage of its contents. The loop of intestine in the hernia becomes blocked up with fæcal matter, and a certain amount of obstruction is thus produced. This blocking is brought about either by a slight increase in the degree of constriction to which the loop is subjected, or by a sluggish movement of the intestinal contents, or by an increase in the quantity of those contents and in their consistence. The condition is most usually seen in cases where a part of the colon is involved in the rupture, and is comparatively rare in forms of hernia other than the umbilical. A loop of small intestine can scarcely be the seat of obstruction in the present sense of the term. The contents of that bowel are fluid, and it is hardly intelligible how a loop of small intestine can become blocked by gas or fluid. The contents of the lower ileum have often the consistence of soft fæces, and a hernia containing a portion of this segment of the bowel may be the seat of an incarceration. The so-called obstructed herniæ of small intestine would be more properly classed as herniæ the seat of a slight degree of strangulation.

The tumour, in cases of obstructed or incarcerated hernia, is increased in size, is tense, is tympanitic in some cases, and dull and doughy to the touch in others. It is seldom markedly tender, although it may be the seat of much pain. Often the swelling can be partially emptied by pressure, or its outline may be altered by the same means. Unlike the tumour in strangulation, there is an impulse on coughing, and although the mass is irreducible, it is not so hard and unyielding as it is in the more serious condition.

The constitutional symptoms are those of severe constipation. There is nausea, and possibly vomiting. The vomiting is never alarming, is never feculent, and is often quite insignificant. There is constipation, but it is not usually absolute, and flatus is often passed. There is some distension of the abdomen, but no grave abdominal pain. The tongue is coated, the appetite is lost; the pulse may be enfeebled.

There is, however, no marked constitutional depression, as in strangulation, and indeed the condition present could only be confused with strangulation in the old and cachectic.

It will generally be found that the patient is liable to constipation; that he has been constipated for some time before the hernia has become obstructed; or that he has been the subject of flatulent dyspepsia, or of some kindred intestinal disturbance.

The *treatment* is simple. The patient must lie in bed. An ice-bag may be applied to the tumour, or the swelling may be emptied as far as possible by manipulation. If there be much pain, opium may be given in small doses. The diet should be scanty, and composed of small quantities of fluid nourishment only. An enema should be at once administered, and repeated several times if necessary. As soon as the local and general symptoms are less urgently marked, a dose of castor oil may be given.

Frederick Treves.

HERNIA, The Radical Cure of.—In the Jacksonian prize essay of the Royal College of Surgeons of 1862, the writer was the first to demonstrate by the results of sixty cases of inguinal hernia the necessity, in the operation for radical cure, of closing up not only the neck and cavity of the sac, but also the deep ring, the sides of the inguinal canal, and the pillars of the superficial ring; and he accomplished these objects, in cases of reducible hernia, by the use of one common ligature applied in a peculiar way. Since that date he has used in 240 cases a stout silvered wire ligature, applied subcutaneously as described in the following pages, with the results of about 20 per cent. of failures and only two deaths. Two hundred of these cases were operated upon successively without a single death.

Since the introduction of the more complete application of the antiseptic method, rendering the dangers of operation less and the success more certain, the author has applied his operation, modified as required, to cases of irreducible hernia, and also to strangulated herniæ after herniotomy. In such cases the sac must necessarily be opened to obtain access to its contents, the removal of a portion of omentum is frequently required, and the risks of the operation are considerably increased.

In his address on Surgery to the British Medical Association at King's College in 1873, the writer advocated the ligature of the deep hernial aperture and the sac at and during the operation for strangulated hernia, after the bowel (not too much damaged) had been returned and a portion of the omentum (if necessary) entirely removed. On that occasion a patient was exhibited upon whom this proceeding had been successfully adopted. Since that time he has operated under spray in thirty cases of inguinal hernia with three deaths, and in eleven cases of strangulated inguinal hernia with one death. In some of these the sac was tied, twisted, and wired or tied across in several places, but in the majority the sac was entirely removed after ligature of its neck. In many, a stout piece of carbolised kangaroo- or ox-tendon has been employed instead of wire, but applied in the same way as had been done in his earlier attempts at the radical cure with ligature-thread and compress.

A similar operation has been performed by him in twenty cases of crural hernia, fourteen of which were cases of strangulation and three of irreducible hernia, with one death and one failure.

Some of the modern operators for the radical cure of inguinal hernia have devoted their attention chiefly to the closure of the pillars of the superficial ring, either by applying subcutaneously catgut, gold, or silver sutures, closing the skin over them, and leaving them in permanently, or for as long a period as the tissues will retain them. Some have, to all appearance, fancied that thereby they have effected an improvement and an important modification in the direction of simplicity upon the writer's method.

Mr. Spanton has proposed and practised a method of closing the canal in reducible cases, which is in its way very ingenious—viz. by the use of an instrument like a corkscrew, applied upon the pillars over and around the fore-finger invaginated into the canal, and left there until union has taken place. Others have, with greater effect, directed attention chiefly to securing the neck of the sac at the internal ring by what is called the *open method.* For this purpose an incision along the whole length of the canal down to the sac is practised, usually under the carbolic spray. Then the sac is opened and its neck is carefully separated from the spermatic cord and tied with catgut. At the same time some surgeons remove the sac altogether; others are content with twisting and stitching it up. In irreducible cases the sac is opened, the adhesions separated, and the omentum, if necessary, removed. The remaining steps of the operation vary with the individual operator, nor would it be within the scope of this article to do more than mention the names of the surgeons who have lately been working for the improvement of this department of surgery.

Professor Annandale of Edinburgh, Professor Stokes of Dublin, and Mr. Mitchell Banks of Liverpool have done good work in this direction. These surgeons stitch up the pillars of the superficial opening either with catgut, wire, or silk cord. In some of his later cases Mr. Banks has included the conjoined tendon, thereby approaching nearer to what the author considers to be an essential step towards the production of a radical closure of the canal. A similar plan has been followed by Sir William MacCormac. This kind of operation has been done abroad, according to Tillanus of Amsterdam, in numerous cases, and also by M. Reverdin of Geneva.

It is very difficult, from the nature of the case, to obtain reliable statistics of the deaths following the open method of operation. Still more difficult is it to get at the real results as to a radical cure. M. Tillanus gives 11 per cent. of deaths as the result in the numerous cases he has collected. The death-results of the recent operations by the open method are very difficult to obtain. Some of the cases operated on by the writer have been very large, and so have some published by Annandale, Banks, and others. The size of the rupture does not seem to influence the mortality as much as might be supposed.

We may conclude, however, that 11 to 12 per cent. of deaths even is too great a mortality to render the open method attractive. No doubt, in correspondence with all analogy, the mortality will decrease as surgeons become more skilful and dexterous in manipulation, and the number of cases multiplies. We may also conclude, from ample experience, that too much reliance cannot safely be placed upon ensuring the complete effect of any kind of antiseptic dressings. The region to which they are applied is a very difficult one upon which to fix and retain the dressings free from septic infection, and a limited size of the wound is of considerable importance from this point of view.

SELECTION OF CASES AND MODES OF OPERATION.—The experience of nearly 400 cases of operation for hernia (from April 1858 to February 1885) has shown the writer that hernial cases differ so much from each other—even those classed necessarily under the same names—that modifications and variations of the operations for the radical cure are absolutely necessary to accomplish fully the purposes of the surgeon. Thus: 1. For simple *reducible inguinal hernia*, which resists the curative effects of careful and continued truss-pressure, the subcutaneous method of applying a thick silver wire to the sides of the canal, rings, and sac is most suitable, both because of its successful results—viz. 240 selected cases of operation, 9 of which were double, and 11 second operations, with (as far as could be followed) 40 failures (18 to 20 per cent.); and because of its safety, only 2 deaths having occurred, 1 from tetanus and 1 from peritonitis, set up independently of the operation. Two hundred consecutive operations by this method, without special antiseptic precautions, were performed by the author without a single death. A modification of this (used in young children), consisting in the employment of two pins instead of wire, has been used in 48 cases more, with 7 failures and 2 deaths, 1 from erysipelas and 1 from peritonitis. For some years these were exclusively the hernia operations practised by the writer, and no cases were operated on except those of reducible and uncomplicated hernia.

2. Cases of *reducible inguinal hernia* in which the omentum was troublesome, slipping down under the truss and dilating the canal progressively. In these the omentum and sac have been altogether removed under spray and antiseptic precautions, and wire, tendon, or catgut has been used for ligature. This operation has been performed in 16 cases, of which 1 died, all the rest being successful.

3. Cases of *irreducible inguinal hernia* incarcerated by adhesions or changes in the omentum, in which catgut or tendon has been used for ligature, the adhesions detached, and the sac and omentum removed. Of these there have been 14 cases, with 2 deaths, but no failures.

4. Cases of *strangulated inguinal hernia* resisting taxis under anæsthetics, in which, under spray, and after the ordinary operation for strangulation, the sac has been tied close up to the deep ring and removed, with or without a portion of omentum, and the inguinal canal closed with wire, catgut, or tendon. Of these there have been 11 cases operated on by the writer, with 1 failure and 1 death from peritonitis, the latter resulting from the injury inflicted on the bowel by the strangulation and not from the operation.

In reviewing the foregoing it will be seen that the mortality increases clearly with the severity of the case, and, therefore, of the operation; and that the result has depended, to a considerable degree, upon the extent of interference with the integrity of the parts concerned in the operation. The nature of the means adopted in the operation, the method of it, and the careful selection of cases fit for the operation, are shown to have some influence by the result of seventeen reducible, but otherwise unselected cases, operated on by the writer's earlier and abandoned method with common ligature-twine and boxwood compress, in the course of which suppuration, as a rule, occurred—viz. 17 cases with 8 failures and 1 death; and also in the pin method, now rarely used, 48 cases (1 double) with 7 failures and 2 deaths. Something considerable, too, must be allowed for improved manipulation and dexterity in operating in the later cases, and for matured judgment and experience—as in all other operations.

Writer's Percentage of Successful Cases. It comes out clearly that, in this operation, the greater number of failures declare themselves during the first two years after the operation. If the operation is not properly done, or from some other cause, the return is evident when the patient removes his truss or ceases to wear it. Consequently, in estimating results, the writer has left out all cases which have not been cured for two years. He has been able to follow (out of a total of 339 cases of the variously modified subcutaneous operation) 96 cases, all of *more than two years'* duration after operation. The longest was twenty-five years after operation, and this was a case of very large rupture, with no truss worn after. Twenty have been examined more than ten years afterwards, and the rest at various periods above two years. In 59 cases there has been a return of the rupture to a greater or less extent, usually before the end of two years. In 152 other cases the patients are known to be cured up to and below two years after operation. The proportion of successful cases in 339 instances of the subcutaneous operation is calculated at from 73 to 82 per cent.

The number of deaths in the 339 cases was five, one of which was from tetanus, and one from causes quite unconnected with the operation. The other deaths were from erysipelas, peritonitis, and pyæmia. Two hundred and twenty subcutaneous wire operations were consecutively performed without a *single* death, and in 240 wire operations there were only two deaths.

Operations for the Radical Cure of Inguinal Hernia.—The instruments used by the writer for these operations are a small scalpel or tenotomy knife, and a stout curved semicircular needle on a strong handle. The concave surface of the needle should be flat, the other rounded. The point must be sharp, but the tapering shoulders of it not sharp enough to cut, but only to split the tissues. Both should be steeped in carbolic lotion (1–20) and plentifully oiled with carbolic oil (1–5). In most of the writer's operations thick copper-wire, silvered, one foot and a half long, has been used to close the canal and rings—wire thick enough not to cut through the compressed structures too quickly, and not so thick as to be inflexible; each end should be bent into a well-made hook. Latterly, however, he has used a stout piece of kangaroo- or ox-tendon, well soaked in carbolic oil for a month at least before. It is applied exactly in the same manner as the wire, but tied in a surgeon's knot instead of the twist of the wire. He cannot yet speak positively as to the respective advantages of these two methods. The tendon is better than catgut, as it is more pliable and does not untwist. It possesses the undoubted advantage, like prepared catgut, of not requiring removal subsequently, and of maintaining its hold of the closed structures until the adhesions and fibrinous effusion set up to replace it are permanent and resisting. The wire sets up more solid effusion and granulation in the track of its passage, and keeps open a straight drain for the escape of any fluid effusion, but it necessitates removal after a week or ten days, and frequently a second administration of anæsthetics.

The patient being anæsthetised and laid on his back, with the shoulders raised and knees drawn up to relax the groin structures, and the pubes and genitals shaved and well washed with a 1–20 carbolic solution, a vertical incision about three-fourths of an inch long is made through all the integumentary structures about one inch below the pubic spine. Sometimes, in old cases which have worn a truss, the superficial external pudic vessels require ligatures at both ends after being divided. The edges of the cut are then detached from the deeper tissues with the handle of the knife; the forefinger purified and dipped in carbolised oil, is passed through the cut, and made to invaginate the deeper coverings and the sac (if scrotal) as far up the canal as the deep ring or hernial opening. Then, by hooking forward the finger, the thickish muscular border of the internal oblique muscle is raised, and the finger is pressed inwards so as to pass behind the edge of the conjoined tendon, raising it well forward. The curved needle is then passed along the concavity of the hand till its point is felt at the tip of the finger, when it is pushed through the resisting structures until its point is seen to raise the yielding skin of the groin at the level of the deep ring. This skin is now drawn inwards towards the median line, and the needle pushed through it. Then the hook of the wire (if wire be used), or the end of the ligature (if tendon or catgut be used), is passed through the eye of the needle and drawn down through both the groin and the scrotal punctures and detached. The invaginating forefinger is then shifted outwards and placed behind the centre of Poupart's ligament, pushing inwards the cord, so as to feel distinctly the groove formed by Poupart's ligament. The latter is then lifted well forwards and kept away from the iliac vessels, which lie directly behind it. The needle is again passed along the concavity of the finger to its point and through Poupart's ligament. When seen to raise the skin, the latter is drawn outwards until the needle-point can be passed through the same aperture as in the previous stage. The needle is then withdrawn, carrying the other end of the ligature or wire through the scrotal puncture. If wire be used, a loop must be left protruding through the groin puncture.

The deep coverings of the cord below the superficial ring are next pinched up by the finger and thumb—and with them the sac of the hernia, if present—at the scrotal opening. The spermatic duct is to be here carefully felt and distinguished, and the needle passed in front of it at one side of the scrotal puncture and out at the other; one end of the ligature or wire is then passed through its eye, drawn back with it, and detached. If wire is used there will now be a loop above at the groin puncture, and two loose ends below at the scrotal incision. The wire must then be pulled upon so as to be straightened out between the loop and the ends, where two twists are to be made and the loop drawn up so as to invaginate and compress all the tissues; the wire is then finally twisted down at the loop end into the groin puncture. With the tendon ligature all that is needed is to tie firmly together the two ends protruding through the scrotal incision in a true surgeon's knot, and to cut off the ends within the incision, stitch up the upper part of the incision if it gapes, and put a few horse-hairs for drainage into the lower part. If wire is used, the ends are bent upwards to the loop, passed through it, and fastened by a single bend, the ends being cut off short. The patient is then put to bed in the sitting posture, with the knees drawn up over a bolster, and fed on milk and beef-tea for a few days.

It will be observed that the steps of the operation are essentially the same whether wire or tendon be used as the retaining medium, the nature of the material employed requiring a little modification of the process. The wire may be withdrawn after a week, ten days, or a fortnight, according to the amount of action set up. Usually there is very little discharge, and the wire comes away with little trouble. The two ends are untwisted and stretched straight, and the loop pulled upon. The two parts of the wire lie usually in the same track, having slowly ulcerated through the tissues and left granulations behind them, which close up firmly by a deep cicatrix the compressed and twisted tissues. The tendon remains in the tissues, and holds them together until the solid effusion which ensues absorbs and replaces the ligature. Upon the perfection of this process depends the permanency of the cure.

By this operation the valvular arrangement of the sides of the normal inguinal canal is restored by the union of the conjoined tendon with the edge of the deep ring, the internal pillar of the superficial ring, and with the fascia transversalis and deeper fibres of Poupart's ligament. This union occurs, if the operation be well managed, close up to the deep ring, and involves its structures also. The obliquely placed ligature embraces both the invaginated sac, the deep ring, the canal, and the superficial ring. The inner limit of the ligature is the edge of the sheath of the rectus, the outer limit is Poupart's ligament. In the numerous operations now performed no trouble has ever been experienced with the epigastric artery. It yields easily to pressure, and cannot be punctured. If included in the ligature, it becomes obliterated without further trouble. The iliac vessels are avoided by lifting up Poupart's ligament well on the finger, and by keeping the needle well in front of the finger. The writer has never had trouble of any kind from this source in all his experience, now very considerable.

Modifications of the Operation.—In cases in which it is thought desirable to open and remove the sac, with or without removal of the omentum, the scrotal incision is carried upwards as far as the superficial abdominal ring, and through all the intervening structures down to the sac itself. The sac is carefully looked for and drawn out of the wound, great care being taken in detaching it from the spermatic duct, which is closely connected with and often totally invested by it. The fingers, forceps, and the handle of the knife are the safest instruments to employ. If it be necessary to use the point of the knife, the incision should be always vertical—i.e. in the direction of the duct, which it is desirable to avoid, and never across it. The sac should be gradually enucleated, and its fundus detached from the tunica vaginalis and drawn out. An opening to admit the finger should then be made, and any omentum which may lie in the sac is thus brought into view. The fundus of the sac is then lifted up and held at right angles to the trunk, while the finger of the surgeon feels carefully for the deep abdominal opening. The sac is then isolated as far up as this point, which is easily done through the dilated superficial ring. If difficulty be experienced, the upper fibres of this ring—i.e. the *intercolumnar*—are to be cut to a limited, but sufficient extent, to allow of a complete investment of the neck of the sac with the ligature. If there be a process of the omentum which it is desirable to remove, this should be first dealt with. All adhesions to the sac, whether of omentum or bowel, which can be easily separated, should be first detached; then the omentum, held firmly by the assistant, should be spread out and examined. A small curved suture-needle, armed with the thinnest catgut, should be passed under the vessels which are seen in the omentum separately, and these should be tied, the ends of the catgut being cut close. Then, the deeper part of the omentum being still held firmly, the portion of it which is beyond the ligatures should be cut off with the scissors. Any oozing points should be tied carefully with the catgut, and the part exposed to the air to see if there be more oozing. The omentum is then allowed to return into the abdominal cavity.

The sac is next dealt with. The forefinger being passed through it to the deep ring, the neck of the sac is twisted round firmly for two complete turns. The handled hernia-needle before described is armed with thick, stout, prepared catgut or tendon, and is passed across the twisted neck of the sac at the point of the finger, close up to the deep ring, a double ligature being left on the withdrawal of the needle. The loop is cut and the four ends tied, two and two, in a firm surgeon's knot, and cut off close. Care must be taken here that the spermatic duct behind the sac is not included in the ligature or injured in any way.

Lastly, the tendinous sides of the inguinal canal are to be secured by wire or tendon in the way before described—viz. through the conjoined tendon close to the edge of the rectus muscle on the inner side, and through the centre of Poupart's ligament on the outer side, the two ends of the ligature, tendon, or wire being brought down into and through the scrotal puncture. There being no sac left in the scrotum, the needle must now be carried across in front of the spermatic cord and closely embracing it, through the fibres implanted into the pubic spine on the one hand and the internal pillar of the superficial ring close to the pubic crest on the other, and the end of the ligature or wire be drawn across, leaving the cord easily movable behind the ligature. If tendon or thick catgut is used for ligature, it must be tied firmly, so as to be quite tight. A surgeon's double knot should always be used. If wire is used, its ends must be twisted as before described, and the loop above drawn upon so as to close up all the tissues involved, and secured as already mentioned. Finally, a drainage-tube should be placed along the cord close up to the ligature, and the scrotal wound closed by sutures.

For the better safeguarding of the patient, the writer is strongly of opinion that the strictest form of antiseptic dressing and treatment should be followed out. He employs Lister's spray method as the most sure and convenient.

In this operation the ends of the wires or ligature are crossed like a bootlace. The superficial ring and canal are thus secured along their whole extent, together with the deep hernial opening. The sac is tied close up to the deep ring, and the possibility of its becoming patulous and again admitting bowel or omentum is removed by its adhesion to the oblique muscles and aponeurosis. The ligature and removal of the omentum, in the cases requiring it, add a still further impediment to a return of the rupture by the stump becoming adherent to the deep hernial opening. There is thus formed, in large and severe cases, a triple barrier against a return of the rupture.

In cases of direct hernia this laced arrangement of the ligature must be carefully carried out, the needle being carried through the tissues close to the border of the rectus muscle, so as to include the margins of the opening in the conjoined tendon. In such cases, there is found not uncommonly an awkward position of the spermatic cord in relation to the sac. It may be found in front of the sac instead of being outside it. It has also been in several cases found to be separated into two parts, one containing the spermatic duct and the other the spermatic vessels and nerves. In all these cases it should be carefully looked for and isolated before lifting out the sac.

In congenital hernia, the fundus of the sac may be left attached to the testicle, and sewn up with fine catgut to form a *tunica vaginalis*, the intermediate portion up to the deep ring being removed.

The writer considers it advisable, in all cases where an elongated piece of omentum is habitually in the sac, to open the latter and to remove the omentum and sac. Nothing is more calculated to dilate the openings than a piece of omentum forced down by abdominal muscular pressure. Experience has shown that in such cases, uncomplicated and in healthy subjects, the ligature and removal of the sac and process of omentum under the spray is a safe enough proceeding; while the result is a more resisting impediment to the return of the hernia.

A still more difficult complication is found in an *imperfect* or *non-descent of the testicle.* This is usually associated with, or followed by, a hernia of the congenital kind, with an open funicular process. The hernial contents are in close contact with the testicle, often passing in front of and below that gland, so as to resemble a hydrocele. This resemblance may be further increased by the presence of fluid from the peritoneal cavity in the sac of the hernia. In these cases the process of peritoneum is usually drawn down by the gubernacular fibres which are attached to it, so as to *precede* the testicle, which is kept back by adhesions in the inguinal canal or abdominal cavity. If, under such circumstances, strangulation takes place or the testicle becomes inflamed, the case is obscured and complicated in a very dangerous manner. In several cases of this kind in young adults the writer has successfully dealt, by one operation, with both the undescended testicle and the hernia also.

By a modification of the operation before described for removal of the sac, the testicle is cut down upon and detached from its connections with the canal and rings. The sac is then tied close up to the deep ring and cut off short. It is again stitched up below with fine catgut, and cut close to the testis, leaving the fundus for a *tunica vaginalis*. The spermatic duct, with its vessels and nerves, is then stretched gently, but firmly, by laying hold of the testis and drawing forwards and downwards. In this way an inch to 1½ inches will usually be gained in length, and the gland may be drawn down and placed in the scrotum so as to lie below the level of the symphysis pubis. It is held in the scrotum by a stout catgut ligature passed with the handled needle through the scrotal tissues below the testis and serous tunic, which are probably the remains of the gubernaculum. The two ends of the ligature are passed separately through the skin of the scrotum and tied over a small pad of carbolised gauze. In some cases, where the cord or spermatic duct did not yield sufficiently to traction, the duct was cautiously separated from the epididymis in the lines of cleavage of the connective tissue, from the globus major down to the globus minor. The gland was then turned upside down, so as to gain the length of its long diameter, and fixed in the scrotum as before described.

The extremely convoluted arrangement of the spermatic duct, and its elasticity within its fibrous envelopes, permit of this stretching without damage to its structure by using too much force. To prevent as far as possible the elastic retraction which follows to some extent, a stout silver wire or tendon suture should be carried deeply through the scrotum directly above the testicle, and this has also been supplemented by elastic traction upon the pad and ligature at the bottom of the scrotum.

In most cases the testicle has become adherent to the scrotum where placed. In some, a certain amount of subsequent retraction has drawn the testicle into the angle between the adductor muscles and the penis. It was, however, in this retired position sufficiently protected from violence or pressure, and was not by any means so liable to be crushed or injured as in its original position in the groin. In one case there has been suppuration in the new tunica vaginalis formed from the fundus of the sac of the hernia. No atrophy of a testicle which was well developed before the operation has occurred. In one case, a child eight years old, in which the testicle was transplanted to enable a truss to be applied to the hernia which followed it, the testis, which was originally wasted somewhat, finally disappeared, either from the operation, or by the truss-pressure subsequently kept up upon the newly formed cicatrix resulting from the operation.

Radical Cure after Herniotomy for Strangulation in Inguinal Hernia.—Since the writer published the first case of this operation in the Address on Surgery at the British Medical Association meeting in August 1873, he has operated in eight cases of *strangulated inguinal hernia* after relief of the strangulation, the intestine being in a comparatively healthy condition—i.e. not sphacelated or ulcerated, but only chocolate-coloured from congestion. The operation was completed by the ligature and removal of the sac, and ablation of diseased omentum; then the sides and rings of the inguinal canal were drawn together by either wire, catgut, or tendon, and the wound stitched up over a drainage-tube. In one case of *reduction en masse* he has done this with complete success. The same operation was done in eight cases of strangulated *crural hernia*. Two deaths resulted, from the damage done by the strangulation and not by the operation.

Operation for the Radical Cure of Crural Hernia.—For this operation the same instruments and appliances as in that for inguinal hernia are used by the writer. The parts, the instruments, and the hands of the operator being carefully purified, the skin closely shaved, and the hernia, if possible, reduced, a vertical incision, 1½ to 2 inches long, is made over the centre of the hernia, and layer after layer of tissue divided with a small scalpel or tenotomy knife until the sac is reached. This is opened on a director, or by the careful use of the scalpel and forceps, and any omentum which may be present is drawn out gently and spread out, so that the vessels which supply it can be recognised. These are to be taken up with the point of the forceps, and tied with the finest catgut, wherever needed. The omentum is then to be held steady by the assistant, and cut off with a pair of blunt bent scissors, or torn carefully with the fingers and forceps.

All the bleeding vessels are to be tied carefully and kept exposed to the air and spray for a while, to make sure that bleeding will not recur. The omentum may then be suffered to retract into the abdomen. The sac is then drawn firmly downwards and forwards. A piece of strong catgut or prepared tendon, doubled, is then to be passed through the neck of the sac, and tied on each side, as high up as possible. The ligature and the sac are cut off close, and allowed to retract into the abdomen. Then the needle is passed through the pubic portion of fascia lata, just internally to the femoral vein, which is to be carefully protected with the forefinger. The point of the needle is carried upwards and forwards, through Poupart's ligament, and brought out at the upper end of the skin wound. A stout piece of prepared tendon is threaded through the eye of the needle and drawn back through the tissues. The needle is then cleared, and passed through the same structures—viz. the pubic fascia lata and Poupart's ligament close to Gimbernat's ligament, the surface and border of which is closely skirted. The other end of the ligature is then threaded through the eye of the needle, drawn down into the wound, and released. If the rupture be a large one, a third ligature may be placed through the same parts, between the other two; or the end of the ligature may be carried across, through, and behind the fascia lata, close to the pectineal line, to obtain a firm hold of those tissues. The ends of the ligature are then tied firmly in a surgeon's knot and cut off short. It will be found, if rightly applied, to close up entirely the femoral hernial opening. A few horse-hairs or a small india-rubber tube, for drainage, should be applied in the lower part of the wound, the upper part of which should be closely sutured with silk and dressed. The patient should be placed in bed sitting, with the knees drawn up. This operation may be performed in favourable cases without taking away either sac or omentum.

Operation for the Radical Cure of Umbilical Hernia.—The operation originated and employed by the writer is performed by the aid of a stout needle, cockspur or semicircular in shape, and with or without handle, carrying a flexible silver wire or thick, stout, aseptic tendon or catgut about 12 or 14 inches long. The instrument and ligature should be steeped for a quarter of an hour in a 1–20 carbolic solution, the patient's navel be well cleaned out, and the neighbouring parts, as well as the operator's hands, be washed with a 1–30 solution.

Then, under an anæsthetic carried far enough to prevent all struggling, the point of the forefinger or, in small cases, the little finger, should press in the protrusion and invaginate the sac so as to make sure that all the parts round the navel are free from bowel and omentum. The needle—unarmed if a handled one be used, but armed with the ligature if an ordinary cockspur or semicircular one be employed—is passed along the front of the finger and made to pierce, from behind, the fibrous structures and skin, about half an inch from the margin of the aperture, leaving a loop at the puncture thus made. The needle and one end of the ligature are then carried round under the skin, close upon the tendinous aponeurosis, just one quadrant of the circle of the hernial aperture, and brought out again to the surface, as in tying a nævus subcutaneously. The needle, if a handled one, is then freed from the ligature. The invaginating finger is again placed on the deep surface of the edge of the hernial opening opposite to this point (or, if preferred, in small cases, the spoon end of a common director can be substituted for it), and upon this the needle is to be again passed through the aponeurosis and skin-aperture occupied already by the ligature, and the end of the latter threaded through its eye and drawn through. These steps are to be repeated for each of the remaining quadrants of the circular hernial opening, carrying the same end of the ligature all round the margins of the aperture and neck of the hernial sac. By traction upon both ends of the ligature (wire, catgut, or tendon) the neck of the hernial sac is closed up firmly, the fundus being gathered up by a pair of hooked forceps and puckered like a sack's mouth when tied. The ligature may be secured by tying or twisting in two separate halves if the case be a large one. By these means the deep surfaces of the peritoneal sac are closely applied to each other in the grip of the ligature. In children's cases stout prepared catgut or tendon should be used. In larger adult cases the writer prefers the use of moderately stout silver wire. The latter ulcerates gradually through the tissues enclosed in its grip, and may, at the end of a week or ten days, be removed with ease on account of the ulcerative action enlarging the track in which it lies. Antiseptic treatment and dressing may be used in both ways of operating. When catgut or tendon is employed it is the more necessary to prevent septic changes, which will cause the ligature to set up suppuration and become discharged, with some delay—perhaps considerable—in the course of the after-treatment.

Two cases of this operation of which notes were kept were in healthy young men. One was afterwards admitted into the army, after having been refused before the operation by the medical examiners. There were no bad symptoms whatever in any of the cases in which the writer has operated, and convalescence was speedy, especially in children.

In the great majority of cases, children can be cured by the maintenance of efficient truss or belt-pressure, carefully applied and sedulously kept up. The writer is of opinion that the pad should be hard, firm, and flat, and should present no boss or projection to be forced into the hernial aperture. If such projection be effective, it delays or prevents contraction of the hernial opening. If not effective, it lies anywhere but opposite to the hernia, and hinders really efficient support to the hernial weakness.

A flat circular disc of lead the sixth of an inch thick and four times the diameter of the hernial opening, slightly bent into a ridge to fit the median abdominal groove when this is deep, covered with wash-leather and held on by a jean or rubber belt, has been found to be the best for children, and seldom fails to cure the rupture in a year or two. When this is borne with difficulty, an air-pad may be fitted to the surface of the metal disc to make it more comfortable and easier to be worn.

In children, the hernia should be cured by pressure before the age of ten years, or be submitted to an operation. Each year after that diminishes the chances of a radical cure.

There are but few adult cases, comparatively, which are good subjects for operation upon this kind of hernia. They are commonly stout, with protuberant abdomens and a large accumulation of intra-peritoneal and surface fat. Often the liver and stomach are troublesome, and sometimes the kidneys are not sound. These patients should be made as comfortable as possible by air-pads, bags, and belts.

In exceptional cases, the radical cure of umbilical or ventral hernia may be attempted after the operative relief of strangulation and division of the point of stricture, by a method of closure of the aponeurotic opening similar to that just described. The sac may previously be tied at the neck with stout catgut or tendon and removed. All should be done with careful antiseptic precautions, and not upon flabby subjects with protuberant and tense abdomens.

With respect to the numerous attempts at the radical cure of hernia by various operators, the conclusion of the author, after a study of the numerous published cases of other surgeons, and the practical experience of his own 409 operations, is that the *mortality* of the operation depends chiefly upon the proper selection of cases, partly upon care and skill in the steps of the operation, and partly upon various accidental risks from other sources; while the *successful issue* depends chiefly upon the skill and experience of the operator, and partly upon due care in the selection of cases and the method of operation.

John Wood.

HERNIA, Reducible.—In this condition the hernia can be completely returned into the abdominal cavity. Herniæ are, in the large majority of cases, slow in their increase; occasionally, however, they suddenly acquire large proportions. In these, which are usually of the inguinal variety, the protrusion descends into a sac already existing, and thus constitutes one of the forms of congenital hernia.

The earliest symptoms of reducible hernia are the presence of a swelling, associated with dyspepsia, lumbar pain, and a sense of weakness in the region through which the hernia is protruding. Whilst the hernia is advancing through the abdominal walls its progress is slow, taking often many months before it becomes complete. After it has once passed beyond the limits of the retention-action of the abdominal muscles, its progress is usually rapid.

Herniæ increase from ill-health, excessive muscular action, and from carelessness, sometimes attaining enormous proportions. If small, the protrusion returns spontaneously when the patient assumes the recumbent position; but if large, some portion of the hernia usually remains down. The hernia is always more easily reduced whilst the patient lies down, but can be returned with varying difficulty even in the erect position. If the protrusion consists of an entero-epiplocele, the intestine is usually the first part to be returned, followed by the omentum. Should the hernia be composed entirely of intestine, the tumour is soft, more or less resonant on percussion, with a distinct impulse on coughing, and yielding frequently a gurgling sound on the taxis being applied; if the hernia consists of omentum, the swelling is soft, doughy, dull on percussion, lobulated, with no distensile impulse on coughing. In adults the intestine is usually returned gradually; in early infancy, owing to its being more tense, the intestine is frequently returned suddenly. Omentum is nearly always replaced gradually, and often with much difficulty.

In the very early stages of a hernia the sac may be reduced, but it soon acquires adhesions to the surrounding connective tissue, and thus becomes irreducible.

The treatment of a rupture consists either in the palliative method of wearing a truss, or in the adoption of the radical cure, which aims at closing the aperture through which the hernia protrudes by operation. *See* HERNIA, Radical Cure of.

The palliative means are those usually adopted. In infancy the truss should be applied as soon as the hernia is discovered, and should be worn day and night, only being removed three or four times in the course of the day for the sake of cleanliness and readjustment. In adults it must be worn in the day-time, and should be applied before rising from bed, and removed after retiring to rest. If the hernia does not descend at night the truss need not be worn, but if any portion should descend, then the instrument should be worn day and night. *See* TRUSSES.

If a patient who is the subject of a hernia begins to wear a truss before the age of ten, a permanent cure may, in the very large majority of cases, be confidently anticipated after wearing a truss for a few years; after the age of puberty the likelihood of recovery is much lessened; while if the hernia appear after twenty years of age, the patient should be advised to wear a truss for the remainder of life, even if there is no descent of the bowel.

JOHN LANGTON.

HERNIA, Strangulated.

—*Definition.* A strangulated rupture may be defined as one in which there is (1) an obstacle to the passage of the gut back into the abdomen; (2) an obstacle to the passage of the intestinal contents; and (3) an obstacle to the passage of blood through the involved loop. These three factors must all be present to constitute a strangulated hernia. If one alone or two alone be present, the rupture is other than strangulated. Thus if there be only an obstacle to the passage of the gut back into the abdomen, the hernia is simply 'irreducible,' while, if there be an obstacle to reduction, as well as an obstacle to the passage of the intestinal contents, the hernia is classed as 'obstructed' or 'incarcerated.'

METHODS OF STRANGULATION. — A knuckle of gut is thrust through a narrow strait or aperture, and, being unable to return, becomes strangulated. When once the bowel has been snared, all further evils which befall it depend indirectly upon the blood-vessels. The vessels are compressed; the blood is unable to return to the great veins; the part swells; the strangulation is thereby rendered more pronounced, and the lack of a supply of fresh blood soon imperils the life of the captured loop. It is obvious that were the intestine non-vascular it could not become strangulated in the usual sense of that term. The gut is thrust through the hernial orifice by a pressure acting from the abdominal cavity. As it is being forced through the narrow aperture, its shape is altered in such a way that its long axis is more or less at right angles to the plane of the hernial orifice. When, however, it has passed through that orifice, it tends to assume its natural outline, and its long axis becomes parallel to the plane of the said opening. Its return, however, is soon rendered still more difficult by reason of the swelling which it undergoes.

The constricting agent is sometimes the neck of the hernial sac itself, sometimes the dense tissues which form the margin of the hernial orifice, and which have indeed moulded the neck of the sac. In recent herniæ, and in congenital herniæ that are of not too long standing, the neck of the sac cannot form the constricting agent. In such ruptures it has indeed no independent existence. If all the tissues about it be cut away, the neck can be drawn out as a part of a perfectly flat piece of peritoneum. If a square bag be pushed through a small ring, it will appear to have a neck where it is encircled by the ring, but if the latter be broken the neck ceases to exist. After a hernia has existed for some time, the plaits and folds into which the peritoneum is thrown at the neck of the sac become matted together; the tissue immediately external to the neck becomes condensed, and the neck acquires an independent existence. In such a case, if all the structures about it be divided, it still exists; and even if the hernial sac be separated from the body, it will still appear as a bag with a definite and rigid constriction for a neck. In certain old ruptures of large size, the neck of the sac may become almost as tough as a ring of cartilage.

In some instances the gut in a rupture has been strangulated by bands of adhesions which pass from one wall of the sac to another, or it has been so compressed beneath a strip of adherent omentum as to be occluded, or it has been closed by being thrust through a slit in a portion of adherent omentum.

There are instances where an occlusion of the bowel, leading to symptoms of acute strangulation, has been brought about by a twisting upon itself of a loop of gut within the hernial sac. Here the strangulation is due to two distinct causes acting in concert, viz. the volvulus of the bowel, and the rigid neck of the sac, or the adhesion within that sac, which has rendered the volvulus possible and has maintained it when once it has formed.

Strangulation commonly follows the protrusion of an unusual amount of intestine. It is thus often ascribed to sudden exertion, to violent expulsive efforts, to injuries causing compression of the abdomen, and the like. In many instances, however, there has been no such feature in the etiology. The rupture has become strangulated while the individual was at rest, and even while asleep. In certain of these cases the patient has been for some time out of health; his tissues are relaxed, or he has been troubled with colic, with severe indigestion, with constipation, with diarrhœa, or some such intestinal trouble. Some authors lay great stress upon the intestinal disturbances that are certainly often to be noted in cases where a rupture has become strangulated without conspicuous cause. They maintain that such disturbances have a paramount influence in the production of the strangulation.

A hernia may become strangulated on its very first appearance, as is not infrequently the case in some congenital inguinal ruptures. On the other hand strangulation may appear for the first time in a hernia that has existed for many years, that has always been reducible, and has never given serious trouble. It may appear in a hernia that is in whole or in part irreducible. When it involves a rupture that has been for a long time wholly irreducible, the symptoms probably depend upon the snaring of a new and recently descended knuckle of gut.

Strangulation is most commonly met with in the herniæ of adults. It is comparatively rare in children and in old age. It is somewhat more often met with in males than in females. Reducible herniæ are more often strangulated than irreducible, small herniæ than large, and congenital herniæ than acquired.

Symptoms.—A typical case.—A labouring man has a common inguinal hernia. Apart from the rupture, he enjoys perfect health. He has had the hernia for several years; it has always been reducible, and he has worn a truss. On several occasions, probably, the gut has come down, and he has had much difficulty in forcing it back again, and, during his efforts to effect this end, the rupture has pained him a good deal, he has felt uncomfortable in his abdomen, and a little sick and faint. On a certain day he goes to his work, and, during some unusual exertion, the rupture suddenly descends behind the truss. He at once removes the truss, and endeavours to reduce the hernia as on previous occasions, but fails. He has a good deal of pain about the neck of the sac, and feels sick and faint. Possibly a cold perspiration breaks out over his forehead. He makes his way home with difficulty and lies down. By this time the sensation of sickness has increased, and he has vomited. The vomiting becomes more marked with each hour that the strangulation exists. He first brings up simply the contents of the stomach, then a yellowish fluid deeply stained with bile. As the case advances, the vomit becomes of a deeper colour, a dullish green, and ultimately a watery fluid that is brown and ill-smelling. It may in time become feculent.

The bowels may act once or even twice after the strangulation has set in. Probably, however, they do not act at all. When sufficient time has elapsed, the patient finds that he is constipated, and that the constipation remains absolute. Not even does flatus pass the bowel. One most conspicuous symptom is the great constitutional depression. The man, who a few hours ago was in vigorous health, is now utterly prostrate. His pulse has become rapid and feeble, and may rise to 120 or 140. His temperature is below normal and remains so; his skin is cold; his face looks pinched; his eyes begin to appear sunken. He looks prematurely old, and such expression as his face may wear is indicative of great anxiety and distress. The tongue becomes coated, is at first white, but soon becomes dry and brown. As the case advances he becomes troubled with intense thirst. Whatever he drinks he vomits again, and the more copious the vomiting the more marked the thirst. The amount of urine that he passes is diminished, and often conspicuously so. If the abdomen be examined, it presents a normal appearance. When the case has lasted for some time, it may become swollen, but the distension will never be great. Besides the pain about the hernia, the patient has severe abdominal pain—pain of the nature of colic, it may be, or a more constant pain that is situate about the region of the umbilicus. The abdomen is not at first tender on pressure, but it becomes so in time, and manipulation of the belly, or examination of the rectum, probably causes increased suffering and an attack of vomiting.

On examining the hernial tumour, it is found to be larger than usual, very tense and even hard, dull on percussion, tender, absolutely irreducible and without impulse on coughing. On percussing the abdomen in the immediate vicinity of the neck of the sac, there may be some dulness due, to the presence of a distended coil above the rupture. If left alone the patient becomes worse hour by hour. The collapse deepens; the vomit may now come up in great gushes, or it may somewhat abate. He does not appear to suffer very acute pain. He lies in bed, restless, yet utterly prostrated, and in a state of faint and desperate misery. The collapse may be such as to resemble that of the algid stage of cholera. The urine may be suppressed. There may be some delirium. In all probability, however, the collapse deepens, and the patient simply dies of exhaustion.

A patient, with an unrelieved strangulated hernia, may die in forty-eight hours, while, on the other hand, he may live a fortnight or even longer. The prognosis in such a case depends upon many factors—upon the age and state of the patient, the nature of the hernia, and the degree and position of the strangulation. Probably the average duration of a case of unrelieved strangulated hernia would be as long as seven days.

Analysis of the Symptoms.—The first symptoms of strangulation are evidently due to the impression conveyed to the abdominal nervous centres by the damage to the bowel; the later symptoms are due in part to this cause and in part to the actual obstruction of the intestine. The small intestine is usually the part of the bowel involved in a hernia. It is supplied by the superior mesenteric plexus of nerves—a plexus of considerable extent, which comes off almost directly from the great solar centre. The faintness, the collapse, the failing pulse, the early vomiting, can all be ascribed to disturbance of the great abdominal nerve-plexuses.

It is obvious that the vomiting, which may appear almost immediately after the strangulation, cannot be directly due to an obstruction in the bowel as far down as —let us say—the lower ileum. The more severe and abrupt the strangulation, the more marked are the symptoms of general constitutional depression and the more pronounced the vomiting. Later on active peristalsis is excited in the gut, above the obstruction, and by means of this movement the vomiting is kept up so long as the obstruction exists. Feculent vomiting may occur when the lower ileum is involved. It would rarely appear before the fourth or fifth day. In any case where the symptoms have lasted many days, the vomited matters possess an offensive smell —'an intestinal odour;' but it is doubtful if they can become really stercoraceous unless the strangulation be low down in the ileum.

The constipation is to be ascribed, in the first instance to the sudden shock given to the abdominal nerve-plexuses, whereby the bowel is paralysed, and in the second to the obstruction. In the majority of cases no motion is passed after the snaring of the bowel, and it cannot be presumed that in all these cases the whole of the intestine below the obstruction is empty. Yet although the colon may be filled with fæces at the time of the accident, those fæces are not evacuated. All the excitement and tumult within the abdomen is taking place in the part of the intestine above the occlusion; the part below remains quiet, inert, and functionless.

The pain experienced depends (1) upon the direct damage to the bowel; (2) upon painful impressions referred to the great solar plexus; and (3) to violent and irregular peristaltic movements in the bowel above the herniated segment. Pain due to the first cause is mostly felt at the neck of the sac, and an examination of that part reveals some tenderness. The fixed pain which patients so often complain of, about and especially above the umbilicus, is, the writer thinks, due to an impression made upon the central nerve-plexuses, to pain referred to the solar centre. Peristalsis of the bowel, above the hernia, causes the colicky, wandering pains which are felt more or less all over the abdomen, and which assume a paroxysmal, although not an intermittent, character. Extreme tenderness of the abdomen is not usually met with in hernia. When present, it probably indicates peritonitis, and is associated with great tension of the abdominal parietes, and increasing meteorism.

The diminished excretion of urine depends partly upon the large amount of fluid lost by vomiting, but to a much greater extent upon the abrupt disturbance in the abdominal nerve-centres. The renal plexuses, it may be observed, are directly derived from the solar plexus and its semilunar ganglia. The diminution in the urinary secretion is most marked in cases attended by severe constitutional symptoms. It has no direct connection with the seat of the strangulation. It is, undoubtedly, usually more marked the nearer the obstruction is to the stomach; but it must be borne in mind that the higher the site of the strangulation, the more severe are the symptoms apt to be, and the more marked and profuse the vomiting. The jejunum, with its muscular walls, its copious blood-supply, its well-developed nerve-plexuses, and its vigorous functional activity, would resent an injury more energetically than would the lower ileum, where the muscular tissue is so much scantier, the blood-supply less free, and functional activity less pronounced.

The local changes in the hernial tumour are all intelligible enough. The most important feature is the loss of all impulse on coughing. The tension of the swelling depends in part upon the increased amount of gut in the sac, in part upon the swelling of the bowel, and in part upon the collection of serum in the sac. The dulness on percussion depends in most cases upon the presence of the serum. It may be due to omentum between the bowel and the anterior wall of the sac. The amount of gas within the herniated loop is often so small, and the swelling of its coats so extreme, that even when the bowel is pressed close to the sac-wall, the percussion note is still dull. From the condition of the gut, the tumour may be expected to be tender on handling, but pronounced tenderness probably indicates hernial peritonitis, i.e. inflammation of the serous lining of the sac and serous covering of the bowel.

Variations in the Symptoms.—The symptoms vary in different cases. The main bases for such variations are the age of the patient, the state of the health, the nature of the hernia, the portion and amount of gut involved, and the treatment adopted. In general terms it may be said that recent herniæ cause more severe symptoms, when strangulated, than do old herniæ; that small strangulated herniæ are more acute than large, and that strangulation of a reducible rupture is usually more serious than that involving an irreducible one. When congenital herniæ are involved, the symptoms are, as a rule, more urgent than when corresponding acquired ruptures are implicated.

It would appear that the symptoms are often less severe when omentum is involved with the bowel, the omentum possibly offering some protection to the intestine. Strangulation is commonly attended with graver manifestations in the young than in the old, and much of the future course of a case depends upon the abruptness and vigour of the strangulation.

It is often seen that strangulated herniæ are attended with urgent symptoms in those who are in vigorous health—in individuals whose processes are active, whose vessels are well filled with blood, and whose nerves respond readily to stimulation; while, on the other hand, in the delicate, the anæmic, the individual whose muscular system is flabby and inert, the course of a strangled rupture is often attended by disturbances of a much more moderate character.

In some of the most acute cases the collapse is very pronounced. There is rapid prostration, the skin is cold, the limbs are cyanotic, the voice is lost, the urine is suppressed, and cramps seize upon the extremities. During epidemics of cholera, this ultra-acute form has actually been mistaken for that disease, and French authors have indeed named it 'cholera herniaire.' On the other hand, in some of the least acute forms, the symptoms develop gradually. There is some colic, some pain in the hernia, some tenderness about it; the bowels do not act, and the patient vomits occasionally, and only, most probably, after food. Three or four days may thus be passed before the characteristic symptoms of strangulated hernia set in. Symptoms of this nature are most commonly met with in ruptures of large size.

Among some of the least usual phenomena met with may be mentioned severe and extensive congestion of the lungs (Verneuil), cramps in the limbs, delirium, and, in children, convulsions.

The three most important and constant symptoms are the constitutional depression, the vomiting, and the constipation. The last-named symptom may, however, be replaced by an evacuation of the bowel below the obstruction.

The local manifestations are liable to variation, and, in the diagnosis of strangulated hernia, must assume a somewhat subordinate position.

When the hernial tumour presents all the characters which have been mentioned in describing a typical case, the evidences of strangulation are very powerfully confirmed; but it must not, on the other hand, be assumed that the absence of one or more of those characters is inconsistent with strangulation, or any evidence that it is not present. The local symptoms may be quite insignificant. In many instances the patient has been quite unconscious of having a rupture, and the swelling has been discovered for the first time by the surgeon. The tumour, moreover, may be of such small dimensions, and so deeply placed, that it can hardly be subjected to examination, and presents characters that are negative or questionable. In some herniæ, such as the obturator and sciatic, it may not be possible to distinguish any tumour after careful examination.

In small herniæ the absence of an impulse on coughing is often difficult to clearly establish. Tumours which are of small or moderate size will probably be dull, hard, and tense. The same characters may be noted in even large swellings. But a patient may present a tumour that is apparently, in all parts, soft, fluctuating, and perhaps resonant on percussion. Yet such a swelling may be the seat of a strangulation. The tumour in such a case will be large, and will contain mainly certain unstrangulated loops, while probably, deep at the neck of the sac, is a little knuckle of strangled intestine which is beyond the reach of the surgeon's touch. Such tumours are usually met with in cases where a large irreducible hernia becomes the seat of a strangulation. On the other hand, a hernial tumour may present the principal characters which are associated with strangulation, and yet not be the seat of the affection. This is seen in connection with small inflamed and irreducible epiploceles, especially when situated in the femoral region. In such a case the little tumour is irreducible, is hard, tense, and dull on percussion, and either presents no impulse on coughing or only equivocal evidence of that symptom. The swelling, moreover, is tender on pressure and painful.

Conspicuous alterations may be noticed in the hernial tumour as the result of certain gross changes in the ensnared bowel or its sac. Thus, when a high grade of inflammation attacks these parts, the tumour becomes more tense and dull upon percussion, more painful and tender, while the skin over it will probably be found red and œdematous.

When gangrene attacks the entrapped intestine, and perforation follows, the tumour may be found to have become soft, and to feel doughy to the touch. It may have ceased to be painful, and may be resonant on percussion from the presence of gas in the sac. When suppuration follows as the result of such a change, the swelling presents the ordinary characters of an abscess (fæcal abscess).

It may now be convenient to consider whether symptoms, similar to those which attend strangulation of the bowel, may attend strangulation of the omentum, and whether the strangulated epiplocele is to be admitted into the clinical conception of a strangulated rupture. That omentum may become strangulated must be admitted, although its physical conditions are such as to render that occurrence much more unlikely to happen than in the case of the bowel. There are surgeons who, while they are compelled to admit the anatomical possibility that omentum may become strangulated in a rupture, yet will not allow that that accident is attended by symptoms in any way allied to, or apt to be confused with, the symptoms of strangulated enterocele. As to the precise symptoms—if any—which attend the strangulation of omentum, they are either silent or at variance with one another, and are thus disposed to ignore the clinical existence of a condition whose anatomical status they readily recognise. They agree in asserting that a strangulated epiplocele cannot give rise to the ordinary symptoms of a strangulated hernia, and the solitary argument upon which this assertion is based, may be expressed in the words of the surgeon who asks, 'If the ligature of omentum, by the surgeon's hands, produce no symptoms of strangulation, how comes it that the comparatively slack constriction of a hernial neck can be supposed to do so?' This question may be at once answered. There is an immense pathological difference between a lesion which merely irritates nerve-filaments and disturbs function, and a lesion which at once destroys nerves and totally annihilates function. The constriction of the hernial neck acts as a severe irritant to the nerves of the part, and greatly disturbs its circulatory conditions; the surgeon's ligature, on the other hand, is so tight that all tissues within its grasp are killed; the parts on the distal side of the thread are at once practically destroyed, and cease to share in the activity of the body.

Strangulated epiplocele may produce symptoms which resemble, and may not always be distinguishable from, those attending a strangulation of the bowel, and into the clinical conception of a strangulated hernia, this form of rupture must be admitted. The special features that may mark the strangulated omental hernia, as compared with the rupture containing bowel, are well described by Mr. Bryant: 'It is characterised by less severe and acute symptoms. They are the same in nature, but different in degree. The pain is less severe, the vomiting not so marked, constipation is less complete and insuperable; the constitutional symptoms are milder; the local distress is also inconsiderable, the tumour permitting manipulation more freely than when it contains intestine. It will also feel harder and more nodular.'

It is quite possible that many instances of hernia, classed as strangulated omental, have been instances of error in diagnosis. For example, symptoms of such severity may attend the inflammation of an irreducible epiplocele that they may be confused with the evidences of strangulation; and, on the other hand, in herniæ containing much omentum, a little strangulated knuckle of gut may be overlooked when kelotomy comes to be performed for the relief of obstructive symptoms.

Littre's Hernia.—This name has been given to a form of strangulated hernia, where only a part of the circumference of the bowel is strangulated by the margin of the hernial orifice. The part of the intestine involved is that most distant from the attachments of the mesentery. When the condition has been relieved, the portion of the wall of the gut which has been strangulated will appear as a sharply-defined, rounded swelling, projecting from the surface of the intestine. It may look, indeed, like a nipple-shaped diverticulum, and, as a matter of fact, in the earliest cases described a small Meckel's diverticulum had found its way into a hernial sac and had become strangulated. The nature of these cases was not recognised, and the diverticulum was supposed to have been produced by the strangulation. In a genuine Littre's hernia normal small intestine is involved, and the little saccular swelling pinched up on the surface of the bowel is produced solely by the constriction. In this form of hernia the intestine may be very firmly held, and a part of its wall so rigorously constricted that it becomes gangrenous, while all the time the lumen of the tube is not obliterated. This form of strangulation is rarely met with, except in femoral herniæ. It occurs usually in quite recent herniæ in young adults, and for the most part in individuals who have no suspicion that they are the subjects of rupture. The symptoms resemble those which are associated with an ordinary strangulated enterocele. They are, on the whole, somewhat less acute, the vomiting is less marked and persistent, and the bowels may continue to act during the whole progress of the case. In many instances the intestine becomes acutely bent or kinked at the seat of the strangulation, and, under such circumstances, the bowel is entirely occluded, and the symptoms differ in no way from those of an ordinary strangulated rupture. In Littre's hernia the tumour is very small, and is often overlooked. When the patient is stout, and the portion of gut occupies the femoral ring, the presence of a tumour may not be detected, even after careful examination. In such instances there will merely be pain and tenderness about the part, in addition to the ordinary signs of strangulated bowel. If the strangulation be not speedily relieved, the ensnared portion of intestine will rapidly become gangrenous.

Diagnosis of Strangulated Hernia. The special points which serve to distinguish a strangulated rupture from one that is merely inflamed or obstructed will be considered when dealing with the two last-named forms of hernia. The symptoms attending an acutely strangulated hernia may resemble those arising from acute peritonitis. In examples of hernia, with ill-marked or misleading local evidences of rupture, the two affections have been confused with one another. The chief points in the differential diagnosis will be found described in the table of diagnosis of intestinal obstruction. *See* Intestinal Obstruction.

A strangulated hernia is readily diagnosed from an internal acute obstruction by the presence and condition of the hernial tumour. Should all local evidences of rupture be absent in any instance, the diagnosis of the two conditions would be obviously impossible. In several cases the abdomen has been opened to relieve a supposed internal strangulation, and the cause of the symptoms found to depend upon a hernia.

In other instances where obstruction-symptoms existed, a hernial tumour has been cut down upon, the gut within it found unimpaired, and the patient's death, or a further operation, has revealed an obstruction deep in the abdominal cavity.

In a child an undescended testicle, which is retained in the inguinal canal and has become inflamed, may, as already stated, give rise to symptoms like those of strangulation. In the diagnosis, the absence of one testicle from the scrotum will be noticed. The surgeon will probably be able to feel and define the upper limits of the tumour. The tumour will be harder than is usual in hernia; it will also be much more painful and more tender. The constitutional symptoms, and the vomiting and constipation, will be all much less marked. Indeed, the local symptoms will usually quite outweigh the constitutional.

The certain diagnosis of the contents of a strangulated rupture is not usually possible. The sac is tense, and distended with fluid. It is uniformly dull, and in all parts equally resisting. There is, indeed, a singular sameness in hernial tumours of like size and position, when they have been for a little while the seat of a strangulation.

THE MORBID ANATOMY may be considered under three headings:—1. The tissues outside the sac. 2. The sac. 3. The contents of the sac.

1. The tissues outside the sac. These will vary in thickness and character according to the anatomical situation of the rupture. They may be found quite normal as the parts are displayed when cutting down upon the sac, or may be the seat of inflammatory œdema, or, when rough taxis has been applied, of some extravasation of blood. In cases of suppuration of the sac, or of the formation of a fæcal abscess, the tissues outside the sac may simply appear as the wall of an abscess. In some instances a well-localised collection of fat has been found between the layers of tissue covering the sac, or has appeared in the connective-tissue layer immediately external to that structure. To such collections the French have given the name 'Lipome herniaire.'

2. The sac. The sac may be entirely absent, as is usual in hernia containing part of the urinary bladder, or it may be incomplete, as is commonly the case when the cæcum is herniated. The adhesion of the sac to the tissues immediately external to it is usually slight, especially in recent and in congenital ruptures. In old herniæ, and particularly in such as are irreducible or have been inflamed, the sac is often closely blended with the parts around it. In any case the neck will be more adherent than the fundus. In recent, and in congenital herniæ, the wall of the sac is thin, but when the rupture is of long standing, and especially after it has been inflamed or the seat of obstruction, it may become thick and dense. The pressure of a truss undoubtedly tends to promote this thickening. The sac-wall may be thick at one part and thin at others. In these latter situations it may have become distended, so as to appear lobed.

In some cases two sacs may be found in the same tumour, as when an external and an internal inguinal hernia have formed on the same side, and the necks of the two sacs are separated only by the epigastric artery. Or, again, there may be two necks to the same sac (hour-glass sac). When this condition exists, a distinct and peculiar hour-glass outline may be given to the rupture. It is supposed that in these cases the original sac of a hernia has been displaced downwards by a fresh protrusion; the original neck then forms the lower constriction or the waist of the hour-glass, while the new sac forms the upper part of the bilobed swelling.

3. The contents. The gut in a strangulated hernia may be found to be free, or the parts of a knuckle may be matted together by old adhesions, or similar adhesions may attach the bowel to the sac-wall. The changes which take place in the snared intestine are as follows:—It becomes congested, the vessels that are at first most conspicuously involved being the veins. The gut becomes a deep purple. It may show arborescent vessels upon its surface, or appear mottled, or display extravasations beneath its serous coat. In the next place it becomes swollen and œdematous. It feels thick, fleshy, and leathery, and is of a deep purple hue. As a further change its surface ceases to be smooth and glistening and becomes dull and sticky, and flakes of lymph may appear upon it. The bowel now loses its elasticity, it feels doughy, and offers no resistance to the finger. It is, in fact, gangrenous. It may present an ash-coloured slough, or may be the seat of a perforation. Where the bowel is constricted, a deep, ring-like groove is formed, which may persist for many days after successful reduction. The perforation, when such exists, may be at the fundus of the loop, and will then probably be small; or a more extensive rupture of the gut from gangrene may be found at the line of the constriction, especially in the upper limb of

the involved loop. The bowel immediately above the strangulated hernia may be perforated, and the escape of the contents into the abdomen be prevented by a number of recent adhesions. In any case the gangrenous change appears to commence in the mucous membrane, and the change is always most advanced in that tunic. The ends of the bowel immediately above the obstruction-line are often fixed to the abdominal parietes about the hernial orifice by recent adhesions. In the interior of the ensnared loop are found flatus, fluid fæcal matter, much mucus, and often a considerable quantity of blood. The mesentery of the strangulated coil is greatly thickened, is œdematous, and often the seat of extravasation.

Any omentum in the sac may be found congested, inflamed, or gangrenous. It may be free or adherent. Its tissue may show none but recent changes, or it may, on the other hand, be found to be dense, tough, and fibrous. Sometimes the gut is entirely enveloped and concealed by omentum. This omentum is adherent to the walls of the sac, and forms the condition known as an omental sac.

The serum in the sac varies in appearance according to the state of the gut. It is at first of a pale yellow colour, clear and bright. As the gut becomes more congested, the serum becomes of a dark brown or purple tint, but remains clear. At a later period it becomes turbid, and is mixed with flakes of lymph. When the gut is gangrenous it has a feculent smell, is opaque and of a dull, brownish colour. The serum may possess a distinct feculent odour without the gut being actually perforated, just as an abscess in close connection with the bowel may contain most offensive pus, without communicating in any way with the interior of the intestine.

Treatment of Strangulated Hernia. The treatment of strangulated hernia consists practically of two measures only—the taxis and herniotomy. If the case be seen almost directly after the rupture has become strangulated, there is no doubt that the best treatment consists in placing the patient in the recumbent position, and at once applying the taxis. This is frequently done by the patient himself, and with perfect success. The writer does not think it desirable to administer an anæsthetic in this early attempt at reduction. If the patient recovers from the anæsthetic with the hernia still unreduced, his symptoms will be found to be aggravated, especially as regards the vomiting. Chloroform or ether should not be administered unless the surgeon has resolved to perform kelotomy in the event of the failure of the taxis. If the gut cannot be reduced on the first attempt, and if the symptoms have only just set in, and there is no vomiting, it is well to try for a while the local application of ice. Some surgeons advise, in the place of ice, a long-continued emersion of the body in a hot bath. This measure, however, is usually very exhausting, and entails an undesirable amount of exertion on the patient's part. What effect the ice will have upon the tumour it will exercise within four or five hours; and if at the end of that time no benefit follows, the prolonged application of the ice-bag is not to be advised. After the ice-bag has been applied for some five hours, or for a longer period, if the symptoms be not urgent, taxis may be once more attempted, and if it again fails, the operation of herniotomy must be perfumed.

Taxis *versus* Herniotomy.—It is usual to consider that of these two procedures the latter is the more serious. The common advice is—'If the taxis fails, resort to herniotomy.' This latter operation is regarded in the light of a *dernier ressort*—a desperate final measure. Comparing, however, these two measures simply as operations, and without regard to their individual merits in any one special case, the writer would urge that the taxis is certainly the more serious and hazardous operation of the two. In the taxis an attempt is made to push the ensnared bowel into the abdomen by main force. There is no question of 'manipulation,' as that term is ordinarily used in surgery. There is no manœuvre of a kind similar to that by means of which the head of the humerus is coaxed into the glenoid cavity after a dislocation. It is merely a question of which is the stronger, the constricting ring or the surgeon's hand. The object upon which this force is expended is a bladder-like knuckle of intestine, whose walls are engorged with blood, are œdematous and softened, and possibly on the verge of gangrene. It is true that the force applied by the surgeon is modified and more evenly distributed by the fluid within the hernial sac, but that fluid is not a protection against all degrees of pressure. The measure, moreover, is an operation performed more or less in the dark. The surgeon may actually be in the anomalous position of endeavouring to introduce into the abdomen a loop of gangrenous intestine. He may readily bring about a perforation, and the only decided effect of energetic taxis may be the introduction of fæcal matter into the peritoneal cavity.

In herniotomy, on the other hand, the parts are not roughly handled; no violence is applied to the delicate and damaged gut. There is a simple incised wound, and a gentle reduction of the ensnared loop, and, in many cases, that is all. It is unnecessary to refer to the opening of the sac, because that is not a *sine quâ non* in kelotomy. It must be remembered that the evil results of improper taxis are commonly placed to the credit of herniotomy. The gut has been seriously damaged by unsuccessful attempts at reduction, herniotomy is performed as a last resort, the patient dies, and another contribution is made to the mortality of the operation. It is impossible to compare the taxis, on the one hand, with herniotomy after taxis on the other. The comparison should be made between taxis and herniotomy without previous attempts at reduction. Of the two operations it must, in strict justice, be owned that taxis is the more fatal, and has been followed by the larger series of lamentable results. A herniotomy is often little more than a clean incision; and the recent vast improvements in the treatment of wounds have certainly helped to make that incision a less serious thing than the crushing of a loop of intestine lying in a state between life and death. The death of the patient can very often be distinctly and directly traced to the operation of taxis, but it is comparatively rare to trace death to the immediate effects of the incision made in kelotomy.

Taxis.—In applying taxis, the parts about the hernial orifice are relaxed as far as possible by the means named in the descriptions of the different anatomical varieties of hernia. The neck of the sac is steadied by the forefinger and thumb of the left hand, while pressure is applied to the fundus by means of the thumb and fingers of the right hand, which should be spread out over the tumour. The nature of the force is a mixture of squeezing and pushing. The pressure should be slowly, evenly, and cautiously applied. The degree of force used must depend upon the judgment of the manipulator. He should keep before his mind the picture of a knuckle of gut, engorged and swollen, protruded through a sharp-edged opening, and possessed of a precarious vitality. Under no circumstances should much force be employed. Violent taxis causes extravasation into the subcutaneous cellular tissue, or into the wall or the cavity of the sac. It may lead to certain displacements of the sac, and to spurious reductions. It may cause rupture of the gut, greatly encourage the development of gangrene and inflammation, and at once render complete a threatening perforation. Violent attempts at reduction always seriously compromise any further measures of treatment. The possible success of the taxis will depend upon data that are both numerous and complicated. Briefly, it may be said that an umbilical hernia is more readily reduced than an inguinal, and an inguinal than a femoral, other things being equal. Upon the same grounds reduction is more likely to be effected in a rupture of moderate dimensions than in one that is either very small or very large. Congenital inguinal herniæ are more difficult to replace when strangulated than are the corresponding acquired forms. The larger a recently-descended hernia has become, the less chance is there of its being reduced, and the same may be said of it the harder and more tense it is.

When the reduction of a knuckle of intestine is successful, the gut passes into the abdomen with a characteristic slip, and often with a gurgling noise; and after its return the sac is found to be empty, and the hernial orifice clear. Omentum, on the other hand, returns slowly and gradually; it does not slip back, nor is its return, of course, attended by any gurgling. Relief of all the symptoms of strangulation follows more or less immediately after the reduction.

There are certain *fallacies* in connection with reduction by taxis which demand close attention. 1. *A successful reduction of strangulated intestine may be erroneously considered incomplete.* This fallacy may arise under these circumstances: there is much omentum in the sac, but only a small knuckle of gut, which is deeply placed. The reduction of the latter may very readily be quite unobserved. In another case there is an irreducible hernia which has existed for years without causing symptoms. Into it descends a small knuckle of fresh intestine, which becomes strangulated. The reduction of this little loop may also escape observation. Or, again, the sac may have an unusually thick or uneven wall, or there may be a localised deposit of fat over it, and after successful taxis it may be thought that something still remains in the sac.

2. *The taxis is considered to be successful, but is attended by no relief to the symptoms.* This may depend upon the following conditions:—1. Reduction *en*

masse. 2. Reduction through a rent near the neck of the sac. 3. Incomplete reduction. 4. Reduction of the gut still strangulated.

1. In the reduction *en masse*, the sac, together with its contents, is pushed forcibly into the abdomen, and as the bowel will still be strangulated by the neck of the sac, the symptoms are in no way relieved. In this event the rupture is made to disappear slowly; there is no slipping back and no characteristic gurgle. After the reduction, a dull, painful tumour may possibly be made out on the abdominal aspect of the hernial orifice. This accident is met with in small and in recent herniæ, and especially in those where the neck is large. It is met with almost exclusively in external inguinal ruptures. In 112 cases of reduction *en masse*, collected by Follin and Duplay, 101 occurred in the subjects of external inguinal hernia, 2 in direct inguinal ruptures, and 9 in the subjects of femoral hernia. A considerable amount of force is required to effect the reduction of the entire sac, and the accident has been frequently brought about by the patient's own attempts at taxis. As soon as the accident is discovered, the canal through which the rupture has escaped should be opened up, the fundus of the sac drawn down and opened, and the ensnared loop liberated.

2. In this variety of pseudo-reduction, the pressure applied to the part causes the sac to rupture. The rent is usually close to the neck, and commonly on the posterior aspect of the sac. By a continuance of the attempts at reduction, the strangled loop is thrust through this rent, and is forced into the subperitoneal connective tissue. In such cases the return of the bowel is effected slowly, and with continued effort. It does not return with a slip, and there is no gurgle. The hernial orifice is found to be still occupied after the supposed replacement, and the symptoms persist. The presence of the strangulated loop in the subperitoneal tissue may be made evident by a dull and tender swelling about the abdominal aspect of the hernial orifice. This accident is met with only in inguinal herniæ, and usually in such as are of the congenital variety. The treatment is the same as for the previous condition.

3. Under certain conditions—as in the very obese—a small, inguinal hernia may be so far returned into the inguinal canal as to be no longer perceived externally, although it remains still strangulated and still unreduced.

4. A loop of bowel lying in a hernial sac may be strangulated by adhesions which pass between the two limbs of the loop, or it may be ensnared by having passed through a slit in the omentum, or between adhesions formed by herniated omentum. Such a loop may be reduced without any relief being afforded to the strangulation. When the reduction is complete, the treatment of the case will demand an opening of the abdomen either in the linea alba, or in the parietes about the hernial orifice.

The consideration of the circumstances under which attempts at reduction by taxis are most to be advised, may be conveniently introduced by pointing out *the conditions in which the taxis is inadmissible*. 1. Attempts at taxis are inadmissible when the parts show evidence of inflammation, when the swelling is extremely tender, and the skin over it is red, hot, and œdematous. 2. In the case of strangulation, involving a rupture which has long been quite irreducible, the prospects of relief by taxis are very remote. 3. The longer the symptoms have lasted in any case, the less marked are the indications for taxis. Every hour renders the possibility of reduction by taxis more distant, and renders the bowel more susceptible to grave damage if roughly handled. It is needless to say that the tumour should not be subjected to manipulation if any suspicion exist that the gut is gangrenous. 4. In recently strangulated herniæ, where the symptoms have not existed for many hours, but have, in spite of their short duration, attained a degree of extreme severity, the taxis had better not be applied. The patient's condition indicates a vigorous strangulation, and the possibility that such strangulation may be overcome by pressure is overbalanced by the still greater probability that the bowel will be seriously damaged by the manipulation. Thus, in the case of very acute strangulation, involving a congenital inguinal rupture in a young lad, an anæsthetic should be at once administered, and if the gut be not reduced by a brief and gentle attempt at taxis, kelotomy should be performed without delay.

Taxis may be tried in cases that come under the surgeon's notice within a short time of the appearance of the symptoms, and in instances of longer standing where the local and general manifestations are but slightly marked. It should never be forcible nor long persisted in, and it would appear that the tendency of modern surgery is to regard this mode of treatment with considerable caution and some little doubt. In all cases, except where the hernia is seen immediately after it has become strangulated, the taxis should be applied under an anæsthetic. Anæsthesia places the patient in a condition most favourable for successful taxis, and reduces to a minimum the amount of force required to effect a reduction.

In any instance where taxis fails, or where it is considered inadmissible, kelotomy must be performed without delay.

Herniotomy or Kelotomy.—The precise incisions required in this operation are detailed in the accounts of the various anatomical forms of hernia. The tissues between the skin and the sac are divided layer by layer, and the outer wall of the sac is exposed. The recognition of the sac is often a matter of difficulty. In recent and uncomplicated strangulated herniæ, the sac is covered by a thin layer of loose cellular tissue devoid of fat. It has a bluish appearance, and all the characters of a thin-walled cyst, containing a darkish fluid. In ruptures of long standing, and in such as have been inflamed or have been unduly compressed by an ill-adjusted truss, or have been subjected to violent taxis, the sac-wall may present a very different aspect. It may be thick, pale, dense, and fibrous ; or thick in one part and thinned in another. Its surface may be irregular, of a dark red colour, and so thickened that it may be readily mistaken for strangulated omentum. It may be closely bound down to the surrounding tissues, so that the finger cannot be passed about it. If the sac is to be opened, a part of its wall should be pinched up with the finger and thumb so as to insure its freedom at that spot from adhesions to its contents, and a small portion of the wall so examined being then seized with dissecting-forceps, the sac is opened. The opening of the sac is indicated by an escape of fluid.

There are certain fallacies which may occur, however, in connection with the opening of the sac. In the first place there may be no sac at all, or but a partial one. As a very rare condition there may be no fluid in the sac, or so little that its escape is not noticed. On the other hand a cyst may be found in front of the sac which, on being opened, may allow of the escape of fluid. Such cysts are usually bursal, and are developed in the connective tissue of the part as the result of the pressure of the truss. Cysts of the spermatic cord, when associated with hernia, are found behind the sac. In certain instances the sac-wall may be so closely adherent to the contents—especially to omentum—that the cavity of the sac cannot be demonstrated, and on continuing the dissection under such circumstances, the bowel has been opened.

If, when the sac is exposed, the tissues immediately outside its neck, which form indeed the hernial ring, be divided in part, the gut may often be reduced without the sac having been opened. Much has been written as to the question whether the sac should or should not be opened. The question is of little moment at the present day. The serious objection urged against the opening of the sac has been that it implied an opening of the peritoneal cavity. Since, however, the application of antiseptic principles to the dressing of wounds, this objection has ceased to have weight. If the sac be not opened, there is risk that the bowel may be reduced into the abdomen still strangulated, or in a condition of gangrene, or in a state of actual rupture or perforation. It must be confessed that these risks outweigh the risks which may be considered to attend the opening of the great serous cavity. It is by no means needful, however, that the sac should be opened as a matter of routine. If the rupture be still irreducible when the parts about the hernial ring have been divided, the sac must of course be opened. It should also be opened in any case when the rupture has been long strangulated, when the strangulation has been very acute, when violent taxis has been employed, and when the parts show evidence of inflammation. In any case of doubt, also, the sac should be opened. If the surgeon has resolved upon opening the sac, then it should be done before dividing the stricturing tissues outside the neck. If the stricture be divided, a piece of ruptured or perforated bowel may slip back into the abdomen before the sac has been opened. In any case where the hernia is very small —as in Littre's hernia and small femoral ruptures—the sac should be opened before the stricture is divided. If this precaution be not taken, the loop—which may be perforated—may slip out of reach into the abdomen. In ruptures that have always been readily reduced, or that are recent and are attended by strangulation-symptoms of slight degree and moderate duration, the reduction may be effected without opening the sac. In very large scrotal herniæ, the opening of the sac involves a special element of danger, in that it exposes a large amount of intestine to the ill-effects of cold, the irritation of sponging, &c., and much manipulation.

When the sac has been opened, and the fluid it contains allowed to escape, the contents must be carefully examined. Their treatment involves much consideration. If the gut be not too seriously damaged, the constrictions which retain it in position must be divided, and the piece of intestine returned into the abdomen. The constriction may either exist in the tissues outside the neck of the sac, or may be found in the neck itself; and in some cases a division of the narrowed parts, in both of these situations, may be needed to insure reduction. The stricture must be divided upon a hernia director by means of a hernia knife, or a suitable, protected bistoury. Care must be taken when the stricture is being divided, that no part of the distended bowel overlaps the edge of the director, and comes in contact with the edge of the knife. When the stricture has been partially divided, it is better to use the forefinger in place of the director. A forcible dilatation of the stricture, with the finger, is inadvisable and likely to cause damage to the bowel.

The state of the bowel can be better judged from its consistence than its colour. So long as the gut appears sound externally, and feels firm and resilient to the touch, it may be safely reduced. When it yields to the finger, and feels soft and flabby, it will most probably be too seriously damaged to be reduced. The colour of the loop alone is no true test of its condition. The surface of the gut is often dull and sticky from peritonitis. This condition is in itself no bar to reduction, but it should be noted that such a loop, after reduction, will probably acquire adhesions to some part of the serous lining of the abdomen. Flakes of lymph, upon the surface of the gut, should not be disturbed if the gut seems generally in fair condition, since they often hide minute perforations. If the bowel be gangrenous or ruptured, the whole portion involved should be well exposed and then resected; the part removed should include a little more of the intestine than the part actually gangrenous. An account of the methods of performing this operation is given under ENTERECTOMY.

When a pinhole perforation exists, it has been advised that the little aperture be closed by a ligature applied as one would apply it to the mouth of a bag, and that the loop be then reduced. Such a procedure is extremely hazardous. The gut about the perforation is possibly gangrenous, or, at least, not in a condition for repair; and the probability of sloughing of the ligatured part, after reduction, is not inconsiderable. In such a case, if the gut be gangrenous about the perforation, the dead segment should be excised. If its condition be doubtful, the loop should be fixed *in situ* by means of sutures that penetrate no deeper than the muscular coat. All constriction having been relieved, an artificial anus is established, which may be dealt with subsequently. If in any case the gut about the perforation appear really sound, then a minute elliptical portion of the bowel-wall may be excised, so as to include the fistulous aperture. The long axis of the ellipse should be parallel to the circular fibres. The margins of the wound should then be united by a deep and superficial set of sutures, and the loop returned into the abdomen.

When omentum is concerned, it should be reduced if its condition permits. If it be gangrenous or very difficult to reduce, or adherent, it should be removed. Its removal should be effected by clamping it just beyond the line of constriction, then excising it with scissors, and securing separately, by means of fine catgut sutures, such vessels as are divided. The cut end is then returned into the abdomen. The practice of including a mass of omentum in one ligature is strongly to be condemned. Equally to be condemned is the practice of leaving the divided or ligatured end of the omentum in the hernial orifice, so that it may form a plug. Omentum, thus rendered adherent, may form an 'omental band,' which may readily become, at some future time, a cause of internal strangulation.

Recent adhesions may be gently broken down with the finger. Old adhesions may be divided with scissors or torn across between two pairs of forceps. Bleeding from the divided ends may usually be arrested by forcible momentary compression of the part with a strong clamp, or, in the failure of this measure, by a touch with the thermocautery. In some cases, where large irreducible herniæ are concerned, the adhesions may be too numerous and extensive to be so treated. Under such circumstances, all constriction having been relieved, the gut must be left *in situ*, and protected—after the healing of the operation wound—by a suitable truss.

When the hernia has been reduced, the abdominal orifice of the sac should be closed. To effect this the attachments of the sac at and about its neck must be freed, so that the neck itself can be pulled down into the wound. It must then be encircled with a stout catgut ligature, which is tied in a firm knot. The ends of the ligature are cut off close to the knot. The treatment of the sac below the ligature permits of much difference of opinion. Some surgeons advise that it be left; others simply cut it across below the ligature, while others excise it entirely. In certain instances, as a species of compromise, a portion only of the sac below the ligature has been removed. In small and recent herniæ, and in herniæ that have not been the seat of inflammation of the sac, the separation of the sac, from the surrounding parts, is not difficult, the only obstacle indeed being the extreme thinness and delicacy of the membrane in recent ruptures. In femoral herniæ, the separation is, as a rule, readily effected. In inguinal ruptures there will be some difficulty in separating the sac from the cord, and this will be especially observed in the congenital forms. In dealing with sacs that have been the seat of inflammation in past times, the toughness of the walls, and the close adhesions that attach themselves to the surrounding tissues, may render the placing of a ligature about the neck of the sac or the excision of the membrane a matter of much difficulty.

As a general rule, it may be said, that when the hernia is of small or moderate size, the entire sac should be excised. In very large ruptures, however, such excision would involve an extensive wound and a tedious dissection; and in these cases, after the neck has been ligatured, the sac should be cut across below the ligature and its cavity well drained.

By the obliteration of the sac, the peritoneal cavity is closed; any bleeding that may occur after the operation cannot take place into that cavity, there is no trickling of serous fluid into the wound, and the hernia is kept up during the healing of the parts. In the case of small ruptures, the procedure may cause the hernia to be permanently retained, and in other cases it has led to such great improvement that the rupture has ceased to give the patient trouble, and has been supported by the lightest truss. From Leisrink's statistics, it would appear, that the rupture recurs in one-third of the cases so treated, while, according to Nussbaum, the hernia re-appears in nearly one half of the cases. Finally, the margins of the hernial orifice should be approximated, whenever practicable, by means of one or two sutures. The sutures may be of catgut or of silver, but the latter are to be preferred. In many cases these sutures are permanently retained. *See* Hernia, Radical Cure of.

The superficial incision may now be closed. A drainage-tube should be inserted, which, in cases where an antiseptic dressing is used, may be removed at the end of twenty-four or thirty-six hours. Firm pressure, by means of pads and bandages, must be applied to the part during the healing of the wound. After the operation, the patient must retain the recumbent position; and in cases where the hernia has occupied any of the orifices about the groin, the thighs should be slightly flexed by means of a pillow placed beneath the knees. No food of any kind should be given by the mouth for twenty-four hours, nor until all sickness, due to the anæsthetic, has ceased. Ice to allay thirst should alone be given. Food excites peristaltic movements, and such movements are undesirable in a segment of intestine that has just been reduced from a hernia. Indeed, for twenty-four or forty-eight hours after the operation, all peristaltic movements should be checked by means of small hypodermic injections of morphia, or, if the patient be not sick, by opium or chlorodyne taken by the mouth. By the use of opium the parts are placed in a condition of perfect rest. The roughly handled or harshly strangled loop of gut can lie quiet and still within the abdomen, and can recover itself at its leisure. The bowels may be allowed to act spontaneously; but if they have not been opened for seven days after the operation, and the patient be in other respects well, an enema should be administered, followed by a dose of castor-oil.

Sequelæ of the Operation.—There are cases where, after successful taxis or successful reduction by kelotomy, the symptoms of obstruction in the bowel persist and lead to death. In such instances the following conditions have been found:—(1) A strangulation of the bowel exists elsewhere, either at a hernial orifice or within the abdomen. (2) The reduced gut lies within the abdomen *hors de combat* and paralysed, and, in such instances, death has followed without the gut having become gangrenous, and without peritonitis having followed. If such a condition be suspected upon fairly good grounds, laparotomy should be performed, and an artificial anus formed in the damaged loop. (3) The gut, which was in a critical state when reduced, has become gangrenous, or it has become so twisted upon itself as to be occluded. (4) Acute peritonitis has set in. In such a case the constipation persists, the vomiting continues, although it may be less frequent and less severe; the pain increases, and is more constant and more diffused; there is general and extreme tenderness; all peristaltic movements cease; the paralysed bowel is distended, and meteorism appears; the temperature usually rises, and the pulse becomes more rapid and more thready. The peritonitis may be due to extension of the mischief from the damaged loop, or may be due to perforation of the bowel, or to the entrance of septic matter into the peritoneal cavity during the operation. FREDERICK TREVES.

HERNIA TESTIS.—By this term is signified a protrusion of the testicle through an opening in the scrotum, due to inflammation of the gland. It is also known as benign 'fungus testis,' and 'granular disease' of the testicle. It has nothing in common with malignant fungus of the testicle, or 'fungus hæmatodes,' which is a protrusion of a malignant tumour of the organ.

1. *Causes.*—The most common causes are syphilitic and tubercular orchitis. Injuries and malaria may lead to chronic orchitis, ending in hernia testis, and very occasionally an acute orchitis leads to suppuration of the testicle and a hernial protrusion. Another form of hernia testis, due to a growth of granulations from the outer surface of the organ, is met with as a sequel of hydrocele, hæmatocele, or pyocele treated by incision of the tunica vaginalis.

2. *Pathology.*—For the pathology of the diseases terminating in hernia testis, *see* TESTIS, Diseases of the; HYDROCELE. It is usually the gummatous form of syphilitic orchitis that leads to hernia. One or more of the gummatous masses in the gland undergoes disintegration, the two layers of the tunica vaginalis over the gumma become adherent, and the superficial tissues of the scrotum inflame and ulcerate, discharging a certain amount of purulent débris and the detritus of the disintegrated gumma. The peripheral part of the gumma then protrudes from the opening in the skin. This may be sloughy in appearance and gradually soften down, or may consist of small pink nodules of seminal tubules with intervening masses of granulation-tissue; as the process subsides, the whole surface may be covered with granulations. The protrusion may consist of a great portion, or even the whole, of the testicle, and the tunica albuginea may be itself everted through the opening in the skin. In some rare instances the affection begins as a syphilitic tubercle in the skin, which gradually enlarges towards the testicle, and then involves that organ, and at last softens down; this is just the reverse of the usual course of events, so far as the order in which the tissues are affected is concerned.

The tubercular disease occurs in the epididymis alone, or in that and the posterior part of the body of the testicle. The exuded material undergoes caseation, and the caseous masses soften down into abscesses. Over these abscesses the superficial tissues become adherent, inflamed, and ulcerated, and the abscesses discharge externally; the caseous or infiltrated walls of these abscesses may then protrude through the orifice in the skin. Where acute orchitis terminates in hernia testis, it is by the formation of an abscess in the gland, which gradually enlarges towards the surface, and bursts externally; the infiltrated tissue forming the wall of the abscess then fungates through the sinus.

In cases of incision into the tunica vaginalis for the cure of hydrocele, hæmatocele, or pyocele, a growth of granulation-tissue from the visceral layer of this serous membrane may take place, and the granulations may at length project beyond the skin-wound. This form is known as *superficial hernia testis.* Where the wound in the scrotum is large, the contraction of the dartos favours the production of this form of hernia.

3. *Symptoms and Diagnosis.*—The symptoms common to all varieties are an ulcer in the scrotum, to the floor of which the testicle is felt to be adherent, and from which a pinkish grey or dull-grey soft fungus projects. The hernia varies greatly in size, and may be so large that but little, if indeed any, of the testicle can be felt within the scrotum. The edge of the ulcer is often thickened, everted, and puckered in, and it is more or less firmly adherent to the subjacent testicle. If the hernia be large, it overlaps the edge of skin, being shaped like a mushroom. The discharge from the sore is pus or sero-pus, and in some cases contains spermatozoa; hæmorrhage is rare, and only slight in amount. The protrusion is soft and yielding to pressure, which may elicit the peculiar testicular sensation. By these signs this disease is readily distinguished from a mere fungating ulcer of the scrotum on the one hand, and a malignant fungus of the testicle on the other. The latter is characterised by the presence of a large, rapidly growing, tumour of the testicle, by an entire loss of the testicular sense, by the livid colour of the protruding mass, and by the frequent profuse hæmor-

rhages from the fungus; also by the enlargement of the cord and the implication of the inguinal or iliac glands. To distinguish between the varieties of benign fungus, the following points must be carefully noted: the history, the part of the testicle affected, the condition of the cord, prostate, and seminal vesicles, and the character of the discharge.

Syphilitic fungus testis is a chronic affection occurring in the tertiary period of the disease; it may be met with in young children. The body of the testicle is alone or chiefly affected; the cord is slightly, if at all, enlarged, and the prostate and seminal vesicles are not enlarged; the discharge may contain spermatozoa. Tubercular fungus testis is also a chronic disease, in which the epididymis is alone or chiefly affected, and the sore is at the back or outer side of the scrotum. The discharge is stated never to contain spermatozoa. The cord is enlarged, and there is very often nodular enlargement of the prostate and seminal vesicle, and signs of tubercular disease of the lungs, kidneys, or bladder; there may or may not be an entire absence of all history of syphilis. The history of the acute onset and rapid progress of the disease distinguishes the rare cases arising from acute suppuration in the testicle. The discharge may contain spermatozoa. The superficial form of hernia testis is recognised by the history of a previous incision into the tunica vaginalis, by the slight amount of fungous protrusion, by the normal or, more usually, enlarged size of the testicle within the scrotum, and oftentimes by the appearance of the granulating surface. The discharge never contains spermatozoa.

4. *Treatment.*—Hernia testis is a curable affection, and the aim of the surgeon is to close up the superficial wound over the protruding mass as quickly as possible. At the same time, the disease which has led to the fungus must be energetically treated. When due to syphilis, the system should be brought under the influence of mercury or iodide of potassium. Where the patient has already been subjected to a thorough course of mercury, iodide of potassium may be given; but where this is not the case, mercury should be given, alone or combined with the iodide. The fungus may be dressed with powdered iodoform, or iodide of starch paste, or unguentum hydrargyri; and then careful compression should be exerted upon the fungus by means of a dossil of lint placed over it, and fixed by strapping brought round the scrotum and crossed over the lint. If the edges of the skin are very adherent and indurated, they may be carefully detached from the subjacent parts, and the above treatment continued. Syme's operation of dissecting up the skin on each side and uniting it over the hernia is usually unsuccessful. When the whole testicle is evidently entirely disorganised, it should be excised; but this operation should not be hastily done, as with patience and perseverance in the treatment recommended, even severe cases may recover, with a more or less useful organ. Where the disease is tubercular, the same local treatment should be carried out, iodoform being the best application to the sore. Internally, cod-liver oil, iron and quinine, combined with good food and residence by the sea, will be indicated. In some cases, where the whole testicle is disorganised, and the disease is still limited to the one organ, castration is clearly indicated. Even where other organs are diseased this may be the best treatment, as causing less drain upon the feeble powers of the patient than discharging sinuses. When the result of acute orchitis, the patient should be kept at rest, and the part should be carefully cleansed and dressed with iodoform or some other unirritating antiseptic agent, and compression applied as in the other cases. The same treatment is applicable to the cases of superficial hernia testis; castration should not be performed.

A. Pearce Gould.

HERNIA, Varieties of. *See* Femoral, Inguinal Hernia, &c.

HERPES.—An acute inflammatory affection of the skin, characterised by one or more groups of vesicles running a definite course.

Herpes Facialis (*Synon.* H. labialis, H. catarrhalis) may accompany slight indisposition of a febrile character (catarrh), or it may occur in the course of severe febrile diseases, pleurisy, pneumonia, typhoid, ague.

Symptoms.—The lips, alæ of nose, more rarely the cheeks, chin, or ears are at first affected by hot œdematous patches of skin, accompanied by a burning or smarting sensation. Soon a crop of pin-head or pea-sized vesicles appear, which, if not interfered with, dry up and fall off at the end of about a week, no scars remaining. When the affection occurs on the lips, the mucous membrane of the inside of the mouth is liable to be affected; here, in consequence of the maceration of the saliva, the epithelium is soon shed from the vesicles, leaving red excoriations. Herpes facialis is prone to recur, especially in certain individuals.

Herpes Progenitalis (*Synon.* H. preputii).

Cause.—The disease differs little from Herpes facialis, and is said to occur in individuals who have been previously attacked by gonorrhœa or syphilis. In some individuals it occasionally follows coitus, in others it invariably does.

Symptoms.—In the male, the prepuce, inner or outer surface, glans, and balano-preputial sulcus are the parts affected; in the female, the labia minora, majora, and adjacent skin. The eruption is similar to that described under H. facialis; only three or four vesicles are usually present; it may be preceded by itching or neuralgic pain. It has been supposed that these neuralgic cases are more allied to H. zoster.

Diagnosis.—When occurring on a mucous surface (inner prepuce, labia minora) the lesions are soon converted into superficial excoriations, covered with a pus-secreting membrane. In this state they may be confounded with a soft sore. The lapse of a few days is sufficient to settle doubt, herpes running a definite short course.

Exposure to infection during an attack of herpes suggests a guarded prognosis, as the lesions may eventually become the seat of an indurated sore and lead to constitutional syphilis.

Treatment.—This need only be local. See *Herpes Zoster* treatment.

Herpes Circinatus, an old term for ringworm.

Herpes Iris (*Synon.* Hydroa), *see* Erythema.

Herpes Zoster (*Synon.* Zona, Zoster, Shingles).

Cause.—An inflammation of the nerve-trunks or ganglia. In some instances this has been shown to be due to traumatic influences, wounds, surgical operations, strain, &c., or to the spread of inflammation from neighbouring growths, &c. In the vast majority of idiopathic cases the cause of this inflammation is obscure. Malaria, cold, damp, have been suggested. Lately it has been shown that patients taking arsenic are peculiarly liable to herpes zoster. Considering the number of individuals who must be exposed to the causes of herpes zoster, and its comparatively rare occurrence, it seems probable that the disease depends upon some personal peculiarity or idiosyncrasy. The affection very rarely recurs.

Pathology.—The inflammatory changes which have been found in the ganglia and nerve-trunks are hyperæmia, cell-infiltration, extravasation of blood, with softening and destruction of the nerve-fibres. The irritation of the inflamed sensory nerve is determined to its peripheral distribution, setting up the peculiar eruption on the skin which has been conjectured to be caused by inflammation of the special nerve-endings (bulbs, &c.) of the cutaneous nerves. The cutaneous lesions early affect the deeper cells of the Malpighian layer—the inflammatory exudation, serum or pus, finally elevating the more superficial layers of the epidermis, and giving rise to the formation of vesicles.

The proximity of the inflammation to the papillæ cutis accounts for the frequent destruction of the latter and the resulting loss of substance.

Symptoms.—The eruption manifests itself at first as hot, erythematous patches, distributed in the course of the cutaneous branches of some cerebral or spinal nerve. Within a few hours papules or minute vesicles are recognisable on the patches. The vesicles rapidly attain their full development; and at the end of four or five days the patch has assumed the typical appearance about to be described. During the first few days fresh patches may continue to crop up, prolonging the climax of the disease to about a week or ten days. At this stage the disease takes the form of clusters of vesicles situated on inflamed patches of skin. The vesicles are mostly lentil or pea-sized, tense, somewhat flat, overhanging their bases; they are filled with a serous or sero-purulent fluid, according to their stage of maturation; not infrequently their contents are purplish from admixture with blood. The vesicles are thickly scattered towards the centre of the patches, where they are liable to coalesce into flat, irregularly-shaped blisters or bullæ. This central group of vesicles is often surrounded by other outlying and similar groups, giving to the whole patch a clustered, or, as it has been termed, corymbose appearance. Having attained its full development, the eruption rapidly declines, the redness subsides, the pus desiccates into yellowish-brown scabs which fall off in a few days; so that usually by the end of a fortnight or three weeks all that remains of the eruption are a few discolorations of the skin, with or without accompanying scars.

The eruption is liable to certain modifications. (*a*) It may abort; the redness may appear, but rapidly subside again, leaving a few scattered pin-head vesicles, which rapidly desiccate. This is specially liable to occur in the remote distribution of the nerve, so that in a case of zoster pectoralis, while typical patches are seen near the spinal groove, the patch corresponding to the anterior branch of the nerve may be abortive. (*b*) Sometimes spontaneously, more often as a result of friction (clothing, &c.), the vesicles are ruptured. Crusts form, and if the irritation is continued the vesicles become the seat of sloughy sores, with more or less infiltrated bases, leading to extensive loss of substance. Names are encountered indicating the region attacked—e.g. Zoster frontalis, Z. nuchæ, Z. brachialis, Z. femoralis, &c. The disease is almost always unilateral, but a few cases of bilateral herpes are recorded. This unilateral distribution of the disease assists the diagnosis, the eruption stopping almost abruptly at the middle line.

Pain is almost a constant symptom of herpes. It may precede, accompany, or succeed the eruption; it may be trifling or severe, and quite out of proportion to the severity of the eruption. Children scarcely complain of it, but in adults it may be of a persistent, gnawing, neuralgic character, destroying rest. In old people it is liable to persist for months, seriously undermining the health.

Besides this essential neuralgic pain, the eruption itself gives rise to smarting and burning during its development.

Certain complications may arise in herpes. (*a*) Trophic disturbances. One of the most serious is the liability for the deeper structures of the eye to become involved in destructive inflammation in cases where the conjunctiva is affected in zoster frontalis. The teeth have been known to fall out in cases where the second division of the fifth has been affected. (*b*) Paralyses (temporary) have been known to precede or accompany the eruption. (*c*) Numbness of the part affected, more or less persistent, may follow the eruption.

Diagnosis.—H. Zoster is to be distinguished from (1) catarrhal herpes, an affection liable to occur about the orifices of the body, mouth, nose, genitals, &c.; not accompanied by neuralgia nor following any nervous distribution, and recurring frequently in the same individual. Anatomically the two eruptions are similar.

(2) From eczema, an itching, not painful affection, characterised in its vesicular stage by small miliary vesicles, evenly and closely set, not running a definite course.

(3) From some vesico-pustular forms of secondary syphilitic eruptions, the grouped arrangement of which may give a superficial resemblance, but which can be recognised by their chance distribution, mode of evolution, and the presence of concomitant symptoms of syphilis.

The early neuralgia, preceding the eruption in zoster pectoralis, with the accompanying difficulty of breathing, has led to the mistaken diagnosis of incipient pleurisy.

Treatment. — Simple, uncomplicated cases of herpes zoster require little treatment; all that is necessary being to warn the patient not to rupture or irritate the vesicles. The clothing should be loosened, and the eruption thoroughly dusted with a dusting powder—*e.g.*: ℞ Pulv. camph. ʒss.; zinci oxidi, ʒiij.; amyli ad ℥j. Absorbent cotton wool should be lightly bound over the part.

It may be necessary to relieve pain during the acute stage by opiates given internally, or by morphia injected subcutaneously; the after-pain may require tonic treatment by quinine, iron, or arsenic. Phosphide of zinc (gr. $\frac{1}{3}$ every three hours), given at the commencement of the attack, is said to control the pain and abort the eruption (Bulkley).

A good plan for protecting the vesicles and relieving the pain locally is to paint on flexile collodion with morphia (gr. x.–f℥j). Glycerine and carbolic acid (1–8), painted on, relieves the smarting, especially if the vesicles be ruptured. In the early stages soothing lotions may be applied to relieve the burning sensations—e.g. lotio plumbi or linimentum calcis.

Duhring says the disease may be most advantageously treated by the constant current, applied directly to the seat of eruption and over the course of the nerves by sponge electrodes (five to ten cells), for fifteen to twenty minutes once or twice a day; the pain and eruption are often arrested thereby. Alfred Sangster.

HERPES FRONTALIS vel OPHTHALMICUS, from the frequency with which it is attended by inflammation of the conjunctiva, cornea, and iris, calls for the surgeon's special notice. It occurs in two forms, the simple and the neuralgic. In the latter, which is in all other respects also the graver, pain, more or less severe, may be felt in the area about to be attacked for days, or even for weeks, before the eruption appears. The parts commonly concerned are the supra-orbital region, the root and side of the nose, the brow, and the scalp—those parts, in fact, which are supplied by the ophthalmic division of the fifth nerve. The precise areas involved are those innervated by the supra-orbital, the infra- and the supra-trochlear, and the nasal branches, and, more rarely, that supplied by the lacrymal branch. In all respects the skin-eruption resembles that of herpes zoster (q.v.). About the time that the crusts of the dried vesicles are falling, inflammation of the conjunctiva and cornea may occur. The keratitis may go on to ulceration and, finally, perforation of the cornea. See *Neuropathic Keratitis* under CORNEA.

With or without the corneal complication, a chronic and obstinate form of serous iritis may occur, accompanied by increase of intra-ocular tension (pseudo-glaucoma), or true glaucoma itself may supervene. The eye is especially liable to be implicated if the nasal nerve have been involved (Hutchinson).

The *pathology* of herpes ophthalmicus is the same as that of herpes zoster. *See* HERPES. The pain and the skin-manifestation are neuropathic, and dependent upon irritative lesions in the Gasserian ganglion and other portions of the fifth nerve.

Diagnosis.—The disease is often mistaken for erysipelas. It may, however, be discriminated by observing its precise unilateral distribution, and the character, site, and mode of grouping of the vesicles, which are situated along the course of the affected nerves, or about their terminations.

Treatment must be local and general. *Local* treatment consists in protecting the skin, and applying soothing and absorbent powders, as oxide of zinc, calamine, starch, &c. If the conjunctiva, cornea, or iris be implicated, a drop of a solution of atropine should be applied once or twice a day, and the eyelids must be kept closed and scrupulously clean. The conjunctival sac may be gently washed once or twice a day with a solution of boracic acid (gr. iv. ad f℥j.), or sulphate of quinine (gr. iv. ad f℥j.). In addition, the lids should be covered by means of a well-fitting compress, on which a layer of boracic acid ointment (gr. xx. ad ℥j.) has been spread, so as effectually to exclude both air and light. The compress should be kept gently but firmly applied by means of a light bandage. In very severe cases, immediate and permanent relief may be obtained by paring the edges of the lids and stitching them together. Not only does the pain at once abate, but the ulcerative process is checked, and repair takes place. The lids should be kept closed, and protected from dust, air, and wind, until pain and all other signs of inflammation have entirely disappeared. This may not take place for two, three, or four weeks, or even longer. When repair is complete the lids may be separated, and the eye gradually accustomed to exposure. At first tinted or other protecting glasses should be worn out of doors or in a bright light.

For the *general* treatment see *Herpes Zoster* under HERPES. J. TWEEDY.

HEY'S AMPUTATION. *See* FOOT, Amputations in the.

HIP, Diagnosis of Diseases and Injuries about the.—The hip-joint lies everywhere under muscular cover, and is in consequence but little open to direct examination. The position of the great trochanter, which can be readily felt, thus becomes of importance as indicating, when displaced with the shaft, an alteration in the normal position of the head of the bone or a separation of the neck of the femur. There are two positions, however, where, by firm pressure, some indication is obtained of the condition of the hip-joint. The first of these is a little below Poupart's ligament, where the joint is crossed by the psoas, iliacus, and pectineus muscles. By extension and rotation outwards, the head of the bone may be thrown up beneath these muscles, and on flexion a slight hollow appears over the position of the joint. The other spot is the hollow behind the great trochanter. Tenderness and fulness may be often detected in these situations when there is inflammation of the joint.

If a healthy person be placed in the prone position, with his legs extended and parallel, the gluteal folds between the buttocks and thighs form a right-angled cross with the vertical interval between the thighs, and its continuation upwards between the buttocks. In hip-disease, the fold of the affected side becomes lowered in position and lessened in depth. This change is brought about by semi-flexion of the thigh and wasting of the gluteal muscles.

Rigidity of the muscles about the hip is an important sign of disease of the joint, especially in children. Normally, the knee may be so flexed as to touch the abdomen without pain, but in hip-disease the motion of the thigh becomes arrested long before this position is reached. On the other hand, if the leg and thigh be straightened so as to lie flat on a couch, the lumbar spine will rise in a curve, indicating that the hip-joint will not admit of full extension. In addition to flexion some adduction takes place, and the writer has pointed out in the Clinical Society's Transactions for 1881 that, as a result of double hip-joint disease, a peculiar deformity may result, whereby one leg is fixed across the other, and the patient walks from his knees instead of from his hips. This he described under the name 'cross-legged progression,' or 'scissor-leg deformity.'

Muscular rigidity will enable the surgeon to distinguish *hip-disease* from *neuralgia* or *sciatica*; but, should he trust too much to this sign, he may overlook disease of the spine and treat it as of the hip-joint, for an abscess, burrowing in the psoas or passing through the sciatic notch, will cause pain and consequent limitation of the movements of the hip. Rigidity, tenderness, and prominence of some part of the spine would tend to clear up the case; but *spinal disease* and hip-disease may co-exist. Semiflexion and limitation of movement may be also caused by *cellulitis in the iliac fossa*, resulting from perityphlitis or spreading from the uterus. In this case resistance above Poupart's ligament will be detected on pressure, and in gentle rotatory movements the hip-joint will be felt to move smoothly.

Osteo-arthritis, affecting the hip-joint, may be generally distinguished by its occurring in the middle or late period of life, its chronicity without tendency to suppuration, the creaking movements, and the occurrence of outgrowths about the trochanter, neck, and acetabulum, which in the later stages may be felt. *Charcot's joint-disease*, which is associated with locomotor ataxy, may cause rapid destruction of the hip, resulting in dislocation without suppuration. Its onset is usually sudden, though little painful, and it is often associated with much swelling of the soft parts, so that it has been mistaken for malignant growth. In its late stages its tendency is towards atrophy of bone and looseness of capsule, whereas the tendency in osteo-arthritis is towards hypertrophic outgrowths, and consequent fixation of the joint. *See* CHARCOT'S DISEASE.

Lameness due to *sacro-iliac disease* may be distinguished from that due to morbus coxæ by proving the movements of the hip to be free, by the pain excited on pressing together the iliac crests, and by the swelling and tenderness usually evident over the affected joint. *Inflammation of the bursa* between the gluteus maximus and great trochanter may obscure the outline of this process. The bursa may be evident in three forms—(1) as a fluctuating swelling due to serous effusion; (2) as a firm tumour due to fibrous deposit in its interior; (3) in a state of suppuration, when there will be tenderness, enlargement of the superficial veins, and a tendency to œdema of the cellular tissue over it. *Sciatic hernia* or an *abscess passing through the sciatic foramen* may cause a tumour at the lower margin of the gluteus maximus, and either may yield impulse on coughing; but the latter will be found associated with disease of the pelvis or spine, and the signs of inflammation will be gradually developed. Hernia, if reducible, passes back suddenly, and often with a gurgle.

If loss of movement and deformity about the hip result from *injury*, a fracture or dislocation is to be suspected. It is thus of great importance to compare accurately one limb with the other. Skilled hands will determine sufficiently the relative positions of the trochanters and iliac crests on the two sides, by placing the thumbs on the anterior superior spines and the fingers over the trochanters. For more exact observation, 'Nélaton's line' is of great assistance. This is a line drawn by a tape or string from the anterior superior spine to the most prominent part of the ischial tuberosity, and its value rests on the fact that it just skirts the upper edge of the great trochanter; consequently, any alteration in the normal position of this process is readily detected. The trochanter is raised above this line in cases of fracture of the neck of the femur, and in three out of the four regular dislocations of the hip-joint. Another way of measuring the elevation of the trochanter has been suggested by Bryant. When the patient is on his back he drops a perpendicular from the anterior superior spine of the ilium, and measures the distance between the trochanter and this vertical line. Shortening of the limb may also be determined by comparing the measurements between the anterior superior spine and the inner malleolus on either side. Forcible extension should not be made when taking this measurement, as, owing to tilting of the pelvis, the limb may thereby be actually shortened instead of being lengthened.

An injury resulting in shortening of the limb, with *eversion* of the foot and elevation of the trochanter, is probably a *fracture of the neck of the femur*. The only dislocation which causes well-marked eversion is the *superpubic*; in this case the head of the bone is felt in its abnormal position. If the injury were caused by a direct fall upon the trochanter, the fracture is probably *extra-capsular* and *impacted*.

The trochanter is widened, there is no crepitus, and the axis of rotation is through a shortened neck. If caused by abduction of the limb in an aged person, it is probably *intra-capsular* and *unimpacted*: the trochanter is normal, the axis of rotation is through the shaft, and crepitus may be elicited by extension and rotation.

When the injury results in shortening of the limb and fixation, with *inversion* of the foot and elevation of the trochanter, one of the two backward dislocations is present. In *superiliac* dislocation, the head of the bone may be felt on the dorsum, the trochanter is prominent, and the shortening considerable. In *supersciatic* dislocation, the shortening is slight, the inversion less marked, and the head of the bone not readily to be found from the outside, though sometimes to be felt in the sciatic notch by the finger passed into the rectum or vagina. In rare cases an extracapsular fracture of the neck is associated with inversion. The movements of the joint are then freer than in dislocation.

If the limb is apparently lengthened, and the trochanter lowered and buried, there is a *superthyroid* dislocation; the foot is then carried forwards and outwards, the body is bent over the thigh, and the adductors are tense.

Pathological and *congenital* dislocations usually take place on the dorsum ilii. A pathological dislocation is apt to become ankylosed in a flexed position, in consequence of which great bending forward of the lumbar spine, or *lordosis*, takes place when the foot is brought to the ground. Congenital dislocations also give rise to lordosis, and a waddling gait is usually noticed as soon as the child begins to walk. R. Clement Lucas.

HIP, Excision of the. *See* HIP-DISEASE.

HIP-DISEASE.—This term is applied to a chronic and often very insidious inflammation of the hip-joint, which, beginning either in the bones or in the synovial membrane, tends to pass on to suppuration and the production of deformity, and in many instances even to a fatal issue; but which, if efficiently treated in its early stage, may in most cases be repaired with little injury to the functions of the limb, and with no impairment of the general health.

By many authorities this affection is considered to be the result merely of neglected local injury, and to be unassociated with any constitutional defect, while by others it is looked upon as strumous or scrofulous. This question can be treated only very briefly in the present article, but it cannot be entirely passed over. The terms struma and scrofula are here taken to be synonymous, and are used to express a defective condition of the general health, with a tendency to various obstinate local inflammations tending to suppuration and caseation—as of lymphatic glands, cancellous bone, mucous and synovial membranes, and the skin. Although in many examples of struma as thus defined tubercle is present, in others no histological elements beyond those of mere chronic inflammation can be detected; and it is only when certain points in their natural history and clinical features are taken into account, that the ground for placing these affections in a distinct group becomes apparent. These points are their common association, in respect of inheritance, with tubercular phthisis; their occurrence in different members of the same family; the development, as we frequently see, of several of them in the same patient; their strong tendency to advance and relapse and to lead to suppuration; and their presence in cases from which the occurrence of local injury can be excluded—for instance, when disease of one of the large joints comes on in a patient who has been in bed for several months for the treatment of spinal caries. These characteristics are so well-marked in a large number of instances of hip-disease that, while many cases may be fairly attributed to mere local injury in patients who are otherwise healthy, the affection, even though originating in an injury, must, speaking generally, be regarded as owing its subsequent progressive tendency to the strumous diathesis. This question, however, is not of so much clinical importance as at first sight it appears to be; for the strumous and the non-strumous cases alike must be treated—in the manner described below—by absolute rest of the joint itself, combined of course with all the means that are calculated to improve the general health. The mistake formerly committed lay in maintaining that, as the disease is often strumous, or, in other words, constitutional, the chief point in treatment must be to provide exercise in the open air, and to regard local measures as of merely secondary importance. It is to this fundamental error in the treatment of this affection that the disastrous results which were formerly so common must be attributed.

Hip-disease, like other affections of the strumous group, although it may be met with at any age up to puberty, or even later, is much more prevalent in early childhood, and commences in a large proportion of cases between the ages of three and seven years. The affection most commonly begins in the bones—either in the head or neck of the femur, or in the acetabulum. It may, however, take its origin in the synovial membrane. The view formerly entertained, that it commenced in the ligamentum teres, or in the cartilage, has been discarded. In the upper end of the femur its starting point is the cancellous tissue just beneath the cartilage, or the line of junction of the epiphysis with the shaft. It may also commence, in more rare instances, in the neighbourhood of the ossific nucleus of the head, or in some part of the neck within the capsular ligament. In the acetabulum, the inflammatory process commonly attacks the line of junction between the three segments of bone which meet in the floor of this cavity. The synovial form may be so acute as to lead to early suppuration, tending to run on to disorganisation of the joint; or it may be chronic and persistent, and attended with the slow formation of matter, or the effusion of plastic lymph, leading to fibrous or bony ankylosis.

In whichever way it commences, the disease, unless it is arrested by treatment, soon involves all the soft structures of the joint, and frequently also both the upper end of the femur and the acetabulum, so that a general arthritis, attended in the great majority of instances with suppuration, is established. As the bones forming the joint are cancellous in structure, the inflammatory process commonly ends in caries rather than in necrosis. Even when necrosis has taken place the sequestra are seldom large enough to be important, and consist of soft fragments, easily broken down and carried away in the discharge. Sometimes, however, in consequence of acute inflammation in the line of junction of the head with the neck of the femur, the whole head, or what remains of it, may become separated from the rest of the bone and form a large loose sequestrum. In the later stages of the disease, the bones, including the upper border of the acetabulum, are extensively absorbed, and the upper end of the femur—though generally remaining in the eroded and enlarged acetabular cavity—is drawn, by the muscles inserted into it, upwards and backwards towards the dorsum ilii. In cases in which the strumous diathesis is very pronounced, chronic inflammation may spread widely in the medullary tissue of the femur, or may lead to the destruction of the whole floor of the acetabulum and the adjacent parts of the pelvis.

Diagnosis.—The recognition of hip-disease in its advanced stage is generally a very simple matter; but this is by no means the case when the affection is still incipient, for the various symptoms are then often but very slightly marked, and, moreover, nearly all the signs of early hip-disease are also the signs of other affections either of the lower limb or of the spinal column. A diagnosis, therefore, can often be arrived at only by a careful study of many slight symptoms, any one of which, taken alone, would be either deceptive or altogether inconclusive. These symptoms, to take them in the order in which they may be most conveniently observed in the examination of a patient, are—

(*a*) *Lameness.*—This condition is always present, though it is often so slight that it may easily escape notice. It may depend either on pain, or on a fixed or distorted position of the limb; but as the sensitiveness of the joint varies in different cases, and as the position of the limb varies in different instances, there is no form of lameness that is at all characteristic of hip-disease, and the symptom is valuable only so far as showing that the patient is unsound, and as calling for further investigation of the case.

(*b*) *Pain.*—The degree to which pain is developed is very variable. In some instances it is so slight, or even so entirely absent, that the disease is not suspected. In others it is from the first very severe. It may be limited to the joint itself, but very often it is referred to those situations lower in the limb to which the peripheries of the obturator and anterior crural nerves, which send offsets to the joint, are distributed—that is, to the knee, or in rarer instances to the middle of the inner part of the thigh or the inner side of the leg. It must, however, be borne in mind that pain is referred to these situations, not only in hip-disease, but also in such widely different affections as disease of the lumbar spine and of the sacro-iliac joint, cancer of the rectum as related by Mr. Hilton, and abscess and aneurism in Scarpa's triangle; every case must, therefore, be thoroughly investigated, so that the real source of the pain thus referred may be ascertained.

(*c*) *Altered Position of the Limb.*—In the early stage of the disease the joint, in a typical case, becomes flexed, abducted, and rotated outwards. The explanation of this position of the limb has been much discussed; it is, however, very simple. The posture is merely that of 'greatest ease,' and is the same as that into which the joint is unconsciously brought when a person sits down with the limbs flexed on the trunk, the knees slightly apart, and the heels touching. It secures the relaxation of all the ligamentous structures of the joint: flexion relaxing the front of the capsule, abduction relaxing the ligamentum teres and the strong outer (ilio-trochanteric) band of the ilio-femoral ligament, and rotation outwards relaxing the inner band of the same ligament and also the back of the capsule. At a later stage the adductors, the most powerful group of muscles around the joint, stimulated to contraction by reflex irritation, gradually draw the limb inwards, so that, instead of being flexed and abducted it now becomes flexed and adducted. Shortening due to absorption of bone commonly takes place at this period, and is indicated by the shifting of the trochanter upwards, or upwards and backwards, in the acetabulum enlarged by the absorption of its upper border. This displacement may be detected by observing that the apex of the trochanter lies above Nélaton's line, drawn from the anterior superior iliac spine to the most prominent part of the tuber ischii. In advanced cases real shortening is often in part due to arrested growth of the limb. Real lengthening, if it ever occurs, is certainly in the highest degree rare. The writer has never seen it demonstrated. Apparent lengthening arises when, the limb being abducted and fixed, the patient wheels it inwards till it is parallel with its fellow, by drawing up the opposite side of the pelvis; while apparent shortening results when, the limb being adducted, the patient wheels it outwards by drawing up the pelvis on the affected side.

(*d*) *Loss of Movement in the Joint.*—This is the most constant and the most conclusive symptom. Cases of hip-disease in which movement is absolutely unimpaired are so rare, that the presence of completely free movement may in itself be taken as all but absolute proof that the joint is sound. It should be remembered, however, that the loss of flexion and extension of the thigh on the trunk is a symptom by no means limited to hip-disease; in psoas and iliac abscess the thigh generally cannot be fully extended; in abscess under the glutei it cannot be fully flexed; it is, therefore, necessary not only to test flexion and extension, but to see whether the ball-and-socket movement, or rotation of the femur in the acetabulum, is interfered with. If rotation is free, it may be concluded that the loss of either flexion or extension depends on some condition external to the joint; if, however, rotation is deficient, this fact will tend to show that the joint itself is affected. This test as to the various movements of the thigh on the trunk must be very gently carried out. If the examination is roughly made, all the muscles will be contracted to protect the joint, and this contraction will be mistaken for rigidity resulting from disease.

(*e*) *Muscular wasting* is a very constant symptom. It is most marked as flattening of the glutei and obliteration of the fold between the nates and the thigh; but it can also be detected, with less annoyance to the patient, by comparing the measurement around the middle of the thigh with that at the same level of the opposite limb. Muscular wasting is often ascribed to non-use of the limb; it is, however, in great part dependent on reflex atrophy, and has its counterpart in the muscular wasting which accompanies disease of all the principal joints.

(*f*) *Swelling.*—This is often absent during the earlier stages of the disease. At later periods it may make its appearance either in front of the joint in Scarpa's triangle, or behind the trochanter, or on the outer aspect of the limb beneath the tensor fasciæ femoris, or in the form of general brawny thickening around the articulation.

During examination, a patient suspected of having hip-disease should be undressed and placed, not on a soft bed, but on a firm mattress or couch, so that the outline of the spine and limb may be clearly ascertained. It must be noticed whether, while the ham touches the couch, the lumbar spine is free from anterior curvature (lordosis); whether the heels correspond; and whether the anterior iliac spines occupy corresponding positions. If, when the limb is down upon the couch, the spine is arched forwards, this is evidence that the thigh is flexed upon the pelvis. The extent of this flexion can be defined by raising the limb till the spinal curvature is removed. If the iliac spine on the suspected side is lower than that on the opposite side, it shows that the limb is abducted—to what extent may be ascertained by moving the limb outwards till the two spines are again level; while if the iliac spine on the suspected side is, on the contrary, drawn up, it indicates adduction, the amount of which may be determined by moving the limb inwards across its fellow till the pelvis is again square. In this manner the real position of the limb on the trunk will be ascertained. Motion should now be tested by carrying the thigh slowly and gently in a direction first of flexion and then of extension, the hand being placed under the loin to see that the lumbar spine remains at rest. Next, the thigh should be carefully rotated to ascertain whether the femur turns freely in the acetabulum. These several movements must be carried to their full natural range; for, in slight cases, it is only when the extreme limits are approached that any stiffness can be detected. Muscular wasting should be investigated, either by observing whether or not there is any flattening of the gluteal region, or by comparing the circumference of the two thighs at the same level. If swelling is present it may be detected by comparing the two sides, or by passing the hand over the surface. Tenderness on pressure, either in front of the capsule or behind the trochanter, is sometimes noticed in cases in which other signs are but little marked; but, unless care is used, the pain of rough handling may be mistaken for the evidence of disease. Jarring of the heel or knee is not to be relied on; it is a test very likely to make a timid child flinch, although the joint is quite sound; while, on the other hand, there are many cases of hip-disease in which the jar produces no complaint of pain.

When these various symptoms have been investigated, the evidence obtained must be carefully weighed. As a rule it is easy to arrive at a definite conclusion; but in some cases the diagnosis can be formed only by combining a number of minor signs. Thus, in one case there is, together with an appreciable limitation of movement —which is, as has already been said, almost invariably present—some slight muscular wasting of the limb; in another, to slight stiffness are added slight apparent lengthening, pain on movement, and rigidity of the adductor longus or some of the other muscles around the joint. In another, with some loss of motion, there may be detected slight flexion, pain in the knee, and fulness in the groin. Negative evidence is sometimes of great value; for if, notwithstanding that the child is lame, has pain in his knee, and keeps his thigh constantly flexed on the pelvis, it is found that there is no stiffness at the joint, but that the head of the femur still moves freely in the acetabulum, it may be strongly suspected that the symptoms depend, not on disease of the hip, but on caries of the spine, or some other affection of the neighbouring parts, and a more extended examination must be made. The affections most likely to be mistaken for hip-disease are caries of the spine, attended with iliac or psoas abscess, or abscess burrowing down under the glutei; infantile paralysis; congenital dislocation of the hip-joint—a more common condition than is usually supposed; and, in young children, the lordosis of rickets, accompanied, as it may be, by a painful condition of the limbs, often present when rickets is acute.

When the disease is allowed to make progress, various complications are developed.

Deformity.—The limb, under the influence of the surrounding muscles, assumes positions which undergo some remarkable changes as the disease advances. At first the thigh becomes more flexed and more abducted—the latter posture being itself the cause of any apparent lengthening; but at a later stage, owing to the preponderating action of the adductors—the most powerful group of muscles around the joint—the limb becomes adducted, or, when the compensatory has been substituted for the real position, apparently shortened, by the drawing up of the pelvis on the affected side. By degrees also, and as the effect of constant intra-articular pressure resulting from muscular action, the joint surfaces are absorbed, and the trochanter travels upwards and backwards upon the ilium, and so considerable real shortening is produced.

Abscess.—In neglected cases suppuration is almost constantly met with, while, even when treatment has been resorted to in an early stage of the disease, abscess in a large number of instances sooner or later is developed. Matter usually forms slowly, so that the abscess is of the cold variety. But in some cases the suppurative process is acute, and attended with a high temperature, night screams, and pain on movement. The abscess is generally formed within the capsule, and subsequently makes its way outwards, either through the cotyloid notch, to reach the surface in Scarpa's triangle, or through the thin posterior part of the capsule, to appear beneath the glutei; or it may pass into the bursa under the tendon of the ilio-psoas (which frequently communicates with the joint), and present itself in the immediate neighbourhood of the femoral vessels. In some cases, however, the abscess is from the first external to the joint, and arises from suppuration among the inflammatory products with which the soft parts have been infiltrated. Such abscesses may appear at any aspect of the joint, though they are most commonly seated beneath the tensor fasciæ femoris, or further down on the outer side of the thigh. A formidable variety of abscess is that which is developed within the pelvis as the result of disease of the acetabulum, and which makes its way to the surface above Poupart's ligament. Suppuration within the pelvis may often be detected by a finger passed into the rectum—a method of examination which it is often useful to adopt in the diagnosis of hip-disease in childhood. The writer has met with four instances in which intra-pelvic abscesses have burst into the rectum, and fæcal material has passed from the bowel through the hip-joint, so as to reach the surface through sinuses opening behind the trochanter. All these were fatal—one after amputation at the hip-joint had been performed.

Amyloid Degeneration.—Should suppuration be copious and of long standing, amyloid degeneration of the internal organs, indicated by enlargement of the liver or spleen and the presence of albumen in the urine, may take place. The period at which this condition is developed varies, however, very much in different instances. In some it is present soon after suppuration has commenced, while in others it makes its appearance only when the discharge of matter has been going on for many months, or even for two or three years.

Tubercular Meningitis. — Formerly, when hip-disease was so frequently allowed to advance to the chronic suppurative stage, tubercular meningitis was by no means a rare complication; but at the present day, when suppuration is so largely diminished by treatment in which rest is combined with the early antiseptic opening of abscesses, it is much less often seen. It may, however, be developed at any period of the disease: in some instances it has occurred when no suppuration had taken place; in others after the joint-affection had long been cured. It always terminates fatally.

It is remarkable that pulmonary phthisis is rarely met with in patients suffering from hip-disease.

Treatment.—In its early stage hip-disease must be treated by absolute rest, combined with the means by which any abnormal posture of the limb may be gradually corrected. The best method for carrying out these indications is that of extension by the weight and pulley. The patient is placed on a firm mattress, with a board beneath it to keep its surface flat. The pillow should be wedge-shaped, so as to support the head in a raised position at a convenient angle; but it should be large enough only to correspond to the head. If it is of the ordinary size the patient raises his shoulders upon it, so that his trunk is no longer in a horizontal position. The weight is connected with the limb by means of the ordinary 'stirrup.' This consists of a piece of stout strapping, from two to four inches wide, which is doubled upon itself at its middle so as to form a long loop, the sides of which are placed one on the inner and the other on the outer aspect of the limb, from the foot to the middle of the thigh, a loop of about four inches in length being formed below the sole. The strapping is kept in place by circular strips, over which a bandage is applied. A thin piece of wood of the shape of a visiting card is placed transversely in the lower end of the stirrup, to prevent the side pieces from pressing on, and excoriating the malleoli. Through the centre of this piece of wood, and through the strapping at a corresponding point, a strong piece of cord is passed, and carried down to the foot of the bed, where it passes over the pulley and supports the weight. The amount of the weight must vary with the case, but in children under twelve years of age from three to five pounds should be used; in young adults as much as six to ten, or even more, may occasionally be required. It is, however, not to its large amount, but to its continuous action, that the weight owes its efficacy in these cases. Very heavy weights put a mischievous strain upon the ligaments of the knee, and often produce œdema of the foot. A cradle should be used to keep the weight of the bed-clothes off the feet.

In the case of a child, the mattress should be protected with a piece of macintosh, covered with a draw-sheet. It is absolutely necessary that, for a time, the patient should be confined to the horizontal posture. To ensure this a long splint should be placed on the opposite, or sound side, and a chest-band will also be useful. This consists of a piece of webbing, an inch or two wide, passing across the upper part of the chest between the two armpits, and ending in two loops through which the arms are passed, and through which, also, another piece of webbing is threaded, which runs transversely across the surface of the bed under the patient's shoulders, and is securely tied at its two ends to the sides of the bedstead. When this contrivance—which ought not, however, to be tightly applied—is worn, the patient can neither sit up nor turn on his side.

In adjusting the limb, the first step is to exchange the compensatory position which it has assumed for its real position. Thus, if there is lordosis, this must be removed by flexing the limb to the necessary extent on the trunk. If the pelvis is oblique, so that the anterior iliac spine on the affected side is lower than that on the sound side, the limb must be moved outwards till the two spines are again at the same level. If, on the contrary, the iliac spine of the diseased side is higher than that on the sound side, the limb must be adducted till the spines are again horizontal. Secondly, in whatever position the limb has now been brought, it must be maintained by pillows, or by some equivalent support, and the pulley must be adjusted in a line with the long axis of the thigh, so that extension is made exactly in this line. In instances in which deformity is extreme, the adjustment of the limb is a matter requiring some ingenuity, and a light wooden framework, covered with pillows, may be necessary to support it. But for ordinary cases sloping or wedge-shaped pillows will be sufficient. The reason for arranging the limb in the manner now described, and making traction in the long axis of the thigh, is that when this is done the weight has a direct tendency to remove intra-articular pressure, while if extension is not thus made in the axis of the deformity, the femur is converted into a lever, whose fulcrum is at the acetabulum, so that the articular surfaces are pressed still more firmly together. As the contraction yields, it is necessary to alter the position of the pulley and the height of the pillows, so that extension shall still correspond with the axis of the thigh. It is often surprising to see how quickly weight-extension thus applied will remove deformity. In recent cases the limb may be restored to its natural position in ten days or a fortnight; while, even in cases of long standing, its position may be corrected in from three or four weeks to two months.

It must be noticed that, although it removes flexion, the action of the weight has little effect on either adduction or abduction, so that when the limb has been restored to a position of extension on the trunk, abduction, showing itself as apparent lengthening, or adduction, taking the form of apparent shortening, will still remain.

Abduction calls for no interference, for it will gradually disappear spontaneously if movement in the joint is preserved; while, should ankylosis result, the presence of abduction, assuming the form of apparent lengthening, will be a distinct gain, for it will tend to compensate for any real shortening that may have taken place. Instances are not rare in which a limb, which has become permanently fixed in a position of abduction, has the appearance of being of the same length as its fellow, though it is in reality shortened to the extent perhaps of an inch or an inch and a half. Adduction is of greater moment, for it has the effect of making the limb practically shorter than its fellow. It is therefore necessary if possible to correct it. This may be done in the following manner. A weight somewhat heavier than that which would ordinarily be used—for a child of five or six years six pounds may, for the present purpose, be employed—is attached to the affected limb in the ordinary way. A long splint is then applied to the sound side, unless this has already been done, and at its lower end is fastened a cord which runs along its outer side upwards to the head of the bed, where it is made to turn over a pulley and sustain a weight of five or six pounds. By this means, while the affected limb is drawn down, the opposite limb is carried in a contrary direction. There are few cases in which, unless firm ankylosis has taken place, this method will not in the course of two or three months completely remove apparent shortening dependent on adduction. Should the limb, in consequence of the absorption of the head of the femur, tend to be everted, this posture may be corrected by the following plan:—An outside splint, long enough to extend from the level of the sole to the knee, and furnished with a cross-piece so that it is T-shaped at its lower end, is applied to the outer side of the limb, and is at first tilted with sand-bags (one of which is placed upon the outer, and the other beneath the inner end of the cross-piece), so that it is rotated outwards to the same extent as the foot and leg. It is then gradually rotated inwards by changing the slant of the cross-piece and altering the sand-bags until, carrying the limb with it, it has brought the latter into its natural position.

Formerly it was the custom, in cases of considerable deformity, to place the patient under the influence of chloroform, and to forcibly straighten the limb. This was a violent proceeding, which often inflicted much injury. It is now very generally, and very properly, discarded. In those instances, however, in which the limb is so firmly held by adhesions that no improvement is obtained by weight-extension, the following plan may be adopted. While the patient is under an anæsthetic, the limb may be straightened by manipulation through two or three degrees, and may then be left again to the action of the weight. It will be very generally found that, after extension has once been thus commenced, the weight will do the rest, and the limb will gradually come down into its normal posture. This proceeding must always be very carefully carried out, and only very slight force ought to be employed.

Mr. Thomas, of Liverpool, has introduced an excellent splint for hip-disease, which has become very popular in England. Made entirely of iron, it consists essentially of a well-padded bar, running along the posterior aspect of the limb from the inferior angle of the scapula to just above the ankle. This bar is easily bent with wrenches to the outline of the trunk and limb, but it is strong enough to maintain its shape when once applied to the patient. At its upper end is a chest-piece, made of iron behind, and ending in a strap and buckle in front, for fastening round the thorax. The splint is kept in place at its lower end by a semi-circlet made of sheet iron behind, and fastening with a strap and buckle round the leg in front. A similar fastening is added at the middle of the thigh. In the lumbar region of the spine the splint is fixed by a wide flannel bandage, surrounding it and the trunk. In acute cases this splint is applied to fix the limb as the patient lies in bed; and if deformity is present, it is fitted to the shape of the limb, and is gradually straightened, so that the position of the limb is corrected. In the later stages of treatment the patient is allowed to be upon crutches and to wear a high boot on the opposite foot, so that the affected limb does not touch the ground.

This splint is very useful, both for the purpose of maintaining the limb, when disease is acute, completely at rest (and for this purpose it may advantageously be combined with weight-extension), and in the convalescent stage, in order to prevent the return of flexion. Children who are wearing this splint can also be lifted without disturbance of the limb. The principal objection to it is that if long-continued it leads to considerable atrophy of the muscles of the thigh. Moreover, as it effects no extension, it does not prevent, when bone-absorption is taking place, the sliding of the upper end of the femur towards the dorsum ilii—in other words, the gradual shortening of the limb. Nor does it exert any direct influence to remove adduction. Thomas's splint, in short, is chiefly useful for the purposes of fixing a limb in acute disease, and for preventing the return of flexion when the patient is up and using crutches. Its simplicity and durability, and the ease with which it can be managed, are strong recommendations of this appliance. While it is in use the patient must be placed on a soft bed, instead of on the firm mattress necessary for weight-extension. A common fault in this splint, as supplied by the instrument-makers, is that it is much too sharply bent where it corresponds with the junction of the nates with the thigh, with the result that it may lead to pressure on the great sciatic nerve to a degree which seriously interferes with the nutrition of the limb. This curvature ought to be modified before the splint is applied.

Mr. Bryant has invented an appliance consisting of two outside long splints, one for each limb, extending from the sole to the axilla, and fastened together at their lower ends by a cross-piece, and at their upper end by an iron rod arched over the chest, so that they are maintained in a parallel position. The object of this double splint is to keep the patient at complete rest, and to prevent abduction or adduction. The various forms of shield splints made of leather or gutta-percha, and the more recently introduced plaster of Paris splint, are all rendered very nearly useless by the fact that as they have very little power to prevent flexion they entirely fail to keep the joint at rest. They are in every respect inferior to Thomas's splint, which ought to be regarded as having completely superseded them.

In America, Taylor's and Sayre's splints, or some of their numerous modifications, are much in use. These appliances, which are described in all American works on surgery, are intended to maintain extension while the patient is allowed to move about in the open air. The defect, however, in all of them is, that it is impossible, except by constant readjustment, to maintain extension, or even to secure adequate rest of the limb. Hence this form of apparatus has never become popular with English surgeons.

It is difficult to say how long treatment in any particular case should be continued. It must be remembered, however, that recovery takes place very slowly, and that relapses are very prone to occur, so that the danger is that time enough will not be allowed. Very few cases, even among those that are treated efficiently from their very commencement, are cured by less than six months of absolute rest, and even eighteen months or two years may be necessary. When weight-extension is the method employed, it should be maintained for at least three months after all pain and tenderness have completely disappeared. Then the weight should be very gradually reduced, and the patient should not be allowed to be up for a month after all extension has ceased. He may then get about with crutches, with a high boot on the sound side, and with a Thomas's splint applied to the affected limb; and this form of treatment must be persisted in for at least another six months, or even a year, at the end of which period Thomas's splint may be left off during the day, although it should still be worn for some months longer during the night, in order to guard against any recontraction of the limb.

It is very important that the formation of matter in hip-disease should not be overlooked, yet large collections sometimes escape notice. If an abscess is detected, it is best to evacuate the collection at once by some means by which septic changes may be prevented. The writer has largely employed Lister's method. A free incision is made, and matter is gently pressed out, so that the abscess-cavity is emptied. A drainage-tube just long enough to enter the abscess is introduced, and the ordinary carbolic dressings are applied. The results have been extremely satisfactory. There is, in the great majority of cases, no rise of temperature, nor any constitutional disturbance. Where suppuration is acute, and connected with inflamed bone, discharge necessarily continues for a time, but the matter quietly escapes through the small sinus which is soon all that is left of the incision, so that no injury is caused to the soft structures of the limb. When the bone-disease, under the influence of rest, comes to an end, suppuration ceases, and the wound quickly heals. In instances in which pus has formed late in the case, and where active disease has come to an end, the abscess has frequently been soundly healed within a month or six weeks, while not a few have been completely closed within three weeks.

The safety with which matter can be evacuated by Lister's method enables us entirely to change the old form of practice in the management of these abscesses, and the early withdrawal of matter may be confidently recommended. When this rule is followed, the wide burrowing of pus in the limb, and the formation of numerous sinuses —hitherto so common an occurrence—is avoided, except in the very few instances in which acute scrofulous bone-disease becomes very extensive, and is attended with wide infiltration of the limb by inflammatory products.

Excision.—Very different opinions are still held as to the value of excision as a means of treating hip-disease. In the view of the majority of surgeons the operation is one that should be employed only in otherwise hopeless cases; for experience, the force of which is daily increasing, shows that if the treatment by rest and the evacuation of matter is efficiently carried out before the disease has reached an advanced stage, recovery, with a much more useful limb than that which is left after excision, will usually take place. The result, however, of excision in cases in which the operation has been performed only after all other means have failed, and in which the general health has suffered considerably, is very unsatisfactory; suppuration often continues to be as free after as it was before the operation, the wound never heals, and the patient dies of exhaustion or visceral disease; or if healing is at last effected, this is only after so long a delay that very little has been gained by the operation. In view of these failures, some authorities have advised that the operation should be performed at a much earlier date—as soon, in fact, as suppuration is detected. If this is done, it is maintained that the wound quickly heals; the local nidus of tubercular disease is removed, so that the danger of systemic infection is averted; and the patient escapes the suffering and dangers which are incidental to the later stages of the affection. The argument, however, which is widely accepted as conclusive against early excision, is the same as that which applies to the case of the removal of a strumous testis in the early stage—namely, that if proper treatment is adopted repair will take place, and the organ may be saved. Other objections to early excision are that the operation is one that cannot be spoken of as free from considerable risk; and that the limb, after even successful excision, is generally much shorter, and much less strong and useful than that which is left when a cure has been obtained without operative interference. Nor is there much force in the proposition that the operation diminishes the risk of systemic infection, for it is impossible to be certain that all infective material (the presence of which, however, is, in the earlier period of the disease, a mere matter of assumption) will be removed, or that other centres of infection do not already exist. Moreover, systemic infection is, after all, so rare, that the possibility of its occurrence is no justification for the sacrifice of such an important joint as the hip.

Although, however, excision generally fails when employed in the later stages of the disease, and although an early resort to it is not warrantable, there are certain conditions in which the operation ought to be performed. These are—(*a*) when the whole or a considerable portion of the head of the femur has become detached, and is lying, as a sequestrum, in the acetabulum or in the cavity of an abscess. This occurrence, which is not very rare, may be suspected when suppuration continues to be copious, and when it is found that the upper end of the femur is abnormally movable, so that it can be pushed upward on the dorsum ilii, and then be drawn down again, especially if grating between the bony surfaces is felt. In these cases—in which, however, what is done is rather an operation for the removal of dead bone than a systematic excision—recovery generally quickly takes place, and a very satisfactory result is obtained. (*b*) When suppuration continues to be copious after three or four months, and the patient is losing flesh and strength in spite of rest and the provision for the free drainage of matter, and when careful examination discloses no evidence of extensive disease in either the femur or the pelvis. If the femur is extensively diseased, it is usually found that sinuses lead to bare bone in the upper end of the shaft; the bone is felt to be enlarged when grasped between the fingers in a direction from before backwards, and there is general brawny thickening of the soft parts, accompanied by burrowing of matter for some distance in the thigh. The formation of sinuses about the ilium, and the fact that a probe, introduced into any openings that may have formed, runs towards the pelvis, will point to the existence of disease of the acetabulum. Important information may also be obtained by exploring the pelvic aspect of the acetabulum with the finger passed into the rectum, when swelling, indicating the presence of an abscess, may sometimes be felt. When the femur is extensively diseased (chronic myelitis sometimes affects the upper third or even more of its shaft) amputation is the only operative proceeding that will suffice. When the pelvis is widely involved, excision will generally be useless, though in some cases it does good by securing free drainage. (*c*) Excision may also be advisable when long-continued and very free suppuration is associated with displacement of the upper end of the femur, attended with deformity which cannot be removed without operative interference. Should albumen appear in the urine, or enlargement of the liver be detected (evidences that amyloid degeneration of the viscera has commenced), the question of excision ought to be carefully discussed, for, if the operation can check suppuration, complete recovery of the internal organs may, and indeed very probably will, take place. It must, however, be remembered that amyloid disease often passes off as the disease subsides under rest and drainage of the joint, so that the mere presence of albumen or of an enlarged liver or spleen does not call for active interference, unless the discharge is very profuse and shows no tendency to decrease. The operation should, therefore, be performed only when it is evident that no improvement is to be expected from further delay.

It is sometimes better not to perform a complete excision, but to operate with the purpose of removing any sequestra that may be present, and of laying open any deep sinuses through which pus may have a difficulty in escaping. Great improvement, or even sound healing, may follow this method of treatment.

The Operation of Excision.—In cases suitable for the proceeding, the operation of excision is limited to the removal of the head and neck of the femur or what remains of these parts. The trochanter should not be taken away, and the soft structures around the bone, including the attachments of the muscles, should be as little disturbed as possible. The method formerly adopted, by which the upper end of the femur was stripped and forced out of the wound, has been superseded by the following proceeding:—A deep incision, four or five inches in length, is made from the base of the trochanter upwards in the direction of the fibres of the glutei; the edges of the wound are retracted, and the capsule, if it remains, is divided, so that the joint is opened from behind. The finger is then introduced to ascertain the condition of the bones and the position of the neck of the femur. A narrow saw is now passed along the finger, the neck is cut through, and the detached portion of bone is removed with sequestrum-forceps with as little violence to the neighbouring parts as possible. If the trochanter or the upper end of the shaft is extensively diseased, they must be removed; but it must be borne in mind that this step seriously interferes with the future usefulness of the limb, and should not be resorted to unless on the ground of clear necessity. The acetabulum must now be explored, and search made for sequestra. If any pieces of bone are found detached, they should be removed; but should the bone be found merely inflamed and bare, it should be left for subsequent healing by granulation. If perforation of the acetabulum has occurred, and abscess has formed in the pelvis, sufficient bone must be removed, with a gouge, to provide for the free escape of pus, and a drainage-tube should be introduced. The wound may be conveniently dressed with carbolic gauze. After the operation, the limb should be placed on a long splint, interrupted at the hip, or it may be supported between sand-bags, a light weight being suspended from the foot to prevent retraction.

Amputation.—Many circumstances have conspired, during the last few years, to induce surgeons to recommend a more frequent resort than formerly to amputation, as a means of treating certain cases of hip-disease. The introduction of the various forms of elastic tourniquet, and of Davy's lever, having provided the means whereby hæmorrhage can be, to a great extent, prevented, the operation has been found much less fatal than was anticipated. It is now known that amyloid degeneration is no bar to operative interference, and that patients often completely recover from this condition when the copious suppuration which has produced it is arrested; while the fact has become more and more clear that, in many cases of advanced disease, it is useless to hope for recovery by the expectant treatment, and futile to resort to excision. It is needless to say that amputation at the hip-joint ought only to be performed when there is good reason to believe that the patient has no other prospect of recovery. The cases in which the proceeding should be adopted are:—(*a*) Those in which there is extensive disease of the femur attended with copious and long-continued suppuration, persisting in spite of rest and free drainage; and in which the patient is steadily losing flesh and strength, and especially when albuminuria or enlargement of the liver is present, to show that amyloid degeneration of the internal organs is in progress. (*b*) When excision has been performed but has failed to arrest suppuration, and the patient's strength is becoming exhausted. An additional ground for resorting to amputation in these cases is that the operation is much more easily and quickly carried out when excision has been already practised. (*c*) When, in spite of careful treatment by rest and drainage, the disease continues to advance, and the patient's strength is not sufficient to enable him to effect repair after excision. (*d*) The operation may, sometimes, be performed in cases of free suppuration connected with extensive disease of the pelvis. The result of these cases must generally be doubtful; but recovery, otherwise hopeless, may perhaps be secured by the provision of such free drainage as is provided by the removal of the limb. Possibly, also, when the limb is removed, diseased bone, not previously within reach, may be got at and extracted.

As the patient is already in a condition of great prostration, care must be taken both to prevent hæmorrhage and to complete the operation with as little delay as is compatible with its careful performance. The bleeding which is most difficult to prevent is that which is derived from the vessels of the posterior flap. This may be guarded against by—1, Davy's lever, or 2, pads may be placed on the external iliac artery, just above the groin and over the posterior vessels as they leave the great sciatic notch; and an elastic tourniquet, made of tubular india-rubber, may be applied firmly, in a circular manner, over these pads.

The method of performing the amputation is a matter of importance. The old plan of transfixion may be rapidly carried out; but it has the disadvantage that the stump is so short that the patient will have little or no power to use an artificial limb in walking. When, however, the muscles are saved, so that a long stump is provided, the patient will be able to use an apparatus with which he can walk in a satisfactory manner; many surgeons, therefore, remove the limb by Furneaux Jordan's method. *See* Hip-joint, Amputations at the. The choice between this method of amputation and that by transfixion must be carefully made, and must depend upon circumstances. If the patient is fairly strong, so that it is thought he can bear a somewhat prolonged operation, it will be right to endeavour to secure for him the advantage of a stump which will enable him to wear an artificial limb; and Furneaux Jordan's operation should be selected. In cases, however, in which great exhaustion is present, the main question is, not what form of stump will be most useful, but how the patient's life can be saved; and in these instances the much more expeditious method of transfixion—when bleeding has been provided against by the use of Davy's lever or a carefully adjusted tourniquet—had better be selected.

Howard Marsh.

HIP-JOINT, Amputations at the.—Amputation at the hip-joint is an operation which, under any circumstances, and no matter what precautions may be adopted to avoid the traumatic accidents liable to occur from the necessarily great size of the wound, must be regarded as one of the most serious in the whole range of practical surgery. The rate of mortality that has hitherto attended it is exceptionally high. Dr. J. Bryant states that in military practice the 'immediate' amputation is attended with a mortality of 93 per cent., in civil practice 60 per cent., and in both combined 80 per cent; in non-traumatic cases it is under 41 per cent., and in the two classes taken together it is a little over 64 per cent. The conditions necessitating the operation, the shock, and the dangers of hæmorrhage and septicæmia, all contribute to make the prognosis in such cases one of the utmost gravity. 'Death,' observes M. Verneuil, 'is sometimes immediate, on the operating table itself; sometimes rapid in the first five hours, sometimes within two hours; at other times it occurs after the first seven days or later. Early deaths are by much the most frequent, ordinarily caused by the hæmorrhage which precedes, accompanies, or follows the operation, and which proceeds not only from the femoral artery, but also from the branches of the gluteal and the sciatic arteries. Later deaths are most frequently the result of blood-poisoning.' The four main factors, therefore, which have hitherto played so important a part in raising the mortality of this operation are:—

1. The serious conditions which necessitate the operation.
2. Shock.
3. Blood-poisoning.
4. Hæmorrhage.

Over the first of these the surgeon has obviously no control; with the second he is almost equally powerless, although there is the authority of Von Langenbeck for maintaining that hæmorrhage intensifies it, but with septicæmia and hæmorrhage he is in most instances able to grapple, and with good prospect of success. As regards the third factor, the absence of surgical fever in the cases the writer has operated upon, in all of which rigid Listerian antiseptic precautions were adopted previously, during, and subsequent to the operation, is evidence of the powerful means that are now at our disposal for striking at those septic influences which have hitherto proved so fatal.

The arrest of hæmorrhage during amputation at the hip-joint can best be effected by one of three methods—(1) the abdominal clamp of Sir J. Lister; (2) Davy's rectal lever; and (3) elastic pressure. In the first of these the defects are threefold—(1) the difficulty of adjustment, especially in cases in which there is any deviation from the normal course of the aorta; (2) the danger to the intestines resulting from overpressure of the instrument; and (3) the interference with the respiratory movements from pressure on the abdominal muscles. The first two of these defects are acknowledged by Sir J. Lister, while the rectal lever introduced by Mr. Davy effectually gets rid of the third, but has itself special dangers, viz. unreliability in checking hæmorrhage where an unusual course of the aorta or common iliac artery exists; besides the necessarily fatal accident of perforation of the bowel resulting from an undue amount of force used in the introduction of the lever. The writer has tested the method in three cases of amputation at the hip-joint. In the first two the lever acted perfectly, the operations being practically bloodless; in the third it was not so satisfactory, the hæmorrhage being such as to give rise to anxiety. Elastic pressure as suggested by Esmarch appears to be the most effectual method, and the one attended with the minimum of danger. A simple mode of making such pressure has been recommended by Mr. Jordan Lloyd. Having first produced anæmia of the limb by an Esmarch bandage, he takes a strip, about two yards in length, of a Martin rubber bandage, and passes it doubled round the thigh at the groin. An ordinary roller bandage is then placed on the external iliac artery, and 'the ends of the rubber are firmly and steadily drawn by an assistant upwards and outwards, one in front and the other behind, to a point above the centre of the iliac crest of the same side.' The portion of the bandage crossing the groin obliquely presses on the roller, which in its turn presses on and occludes the external iliac artery, and the other portion, passing behind, closes the gluteal vessels, bleeding from which gives as a rule in this operation most trouble and anxiety.

The following are the methods by which amputation at the hip-joint may be performed:—

I. Single flap (anterior or internal).
II. Double flap (antero-posterior or lateral).
III. Oval.
IV. Circular.
V. Modified circular.

The first of these procedures may be thus described:—

The parts about to be operated on having been rendered aseptic, anæsthesia induced, and some of the measures already mentioned taken to prevent hæmorrhage, the patient should be so placed on the table that the pelvis should project beyond its edge. The scrotum should be drawn aside by an assistant with a broad bandage or cloth; another assistant should stand beside the operator to take charge of the anterior flap and, if necessary, make pressure on the femoral artery; a third should support the condemned limb and thoroughly understand when to flex, extend, abduct, and adduct the limb during the performance of the operation. The thigh being slightly flexed on the pelvis the operator takes a long narrow-bladed catlin (Liston's), the cutting portion of which should be at least twelve inches in length, and should enter it at a point midway between the anterior superior spine of the ilium and the great trochanter, and carry it inwards and backwards to a point an inch below and in front of the tuber ischii. This step of the operation, if done skilfully, should open the capsule of the joint. The operator then with a rapid sawing movement carries the knife longitudinally downwards and forwards, during which manœuvre the assistant passes his fingers behind the flap, as soon as room is afforded him, in order to make, if necessary, pressure on the femoral artery. The termination of the flap should correspond to the junction of the upper and middle thirds of the thigh. The anterior flap having been formed, reflected, and compressed by an assistant, the limb should be extended and abducted, and the capsule, thus made tense, freely opened. The head of the bone will now protrude, and the round ligament and posterior portion of the capsule should then be divided. The limb should then be rotated inwards, and the attachments to the great trochanter divided. The knife is then placed behind the bone, and the posterior tissues divided obliquely downwards and forwards.

In performing the *antero-posterior* or double-flap operation, the long anterior flap having been formed in the manner described, the knife is carried round and under the thigh and a lunated incision involving the integument and fascia made, connecting the two extremities of the anterior flap. The deeper tissues are then obliquely divided, following the edge of the retracted skin, and a short posterior flap thus made, one-third in length of the anterior flap. This method the writer has always adopted.

In the *oval method*, recommended by Verneuil, the operator makes a vertical incision about two inches in length, involving only skin and fascia, commencing an inch below Poupart's ligament. This incision is then carried downwards, outwards, and backwards, then transversely along the gluteal fold, and finally obliquely upwards and inwards to the termination of the vertical incision. The femoral vessels having been exposed, and the artery ligatured above and below the origin of the profunda, the latter vessel in its turn is also secured. Ligature of the femoral vein is likewise recommended. The deeper incisions through the muscles following the line of the integumentary incision are then made, every divided vessel being ligatured. The capsule is then opened and the trochanteric muscular attachments divided, the thigh having been depressed, and the head of the bone protruded. On the removal of the limb a large gaping wound will result, which cannot be closed. This M. Verneuil considers an advantage, as no accumulation of fluids liable to undergo putrefactive changes occurs. The wound is dressed on the 'open' principle with pledgets of lint or charpie soaked in some antiseptic solution. The writer does not recognise the alleged merit of this procedure.

The *circular method* of amputation is performed by making an incision, involving primarily only skin and fascia, at a distance of from six to eight inches below the anterior superior spine of the ilium. The skin is then retracted, and the superficial and deep layers of muscles successively divided. The bone is then reached, the capsule freely divided close to the cotyloid cavity, the muscular trochanteric attachments divided, and the head of the bone made to protrude by depressing and abducting the thigh. This method is preferable to that which immediately precedes it.

Mr. Furneaux Jordan (*Lancet*, March 22, 1879) has proposed a mode of amputating at the hip-joint for which he claims many advantages. The principle of the operation is a primary enucleation of the bone and a subsequent division of the soft structures of the thigh at any desired spot, 'the middle of the thigh, or below, or even near the knee.' A straight incision is first made, the trochanters and upper part of the shaft are freed from their muscular attachments and the capsule opened. The shaft is then cleared downwards from all its attachments for a considerable distance and lastly 'a few free sawing movements with a long-bladed knife through the thigh from which the bone had been removed' complete the operation. The advantages claimed for this operation over that usually performed are—the wound being less severe, the cut surfaces less extensive, less shock, less hæmorrhage, and less opportunity for septic infection. The absence of the bone enables the operator to cut the muscles on, or nearly on, a level with the skin, their retraction under these circumstances being so great that the skin readily covers them.

The operation would clearly not be indicated in cases where the soft tissues were much engaged or in cases of malignant disease, and it leaves necessarily a large pendulous, boneless mass. These defects may, not altogether without reason, be advanced as arguments against the operation. William Stokes.

HIP-JOINT, Dislocations of the.—These injuries are rare, and few surgeons can claim a very large experience of the various displacements, whilst the opportunities for making recent dissections are very limited. Consequently, much that has been written concerning the pathology of dislocations at the hip has been founded on experiments made upon the dead subject. This method of inquiry, though useful, is scarcely reliable; and the results require to be checked by more careful dissections of recent cases. Fabbri, who made a series of elaborate experiments, and laid down rules for the artificial production of the various dislocations, has been followed on the same lines by Tillaux and H. Morris. The general result of these observations is to the effect that, the lower part of the capsule being the weakest, and the lower edge of the acetabulum the least elevated, in all dislocations of the hip the head of the bone escapes primarily through this region, and arrives secondarily at its characteristic position. Further, according to Morris, abduction is the position in which all dislocations of the thigh happen. This scarcely accords with clinical experience. Thus, a case of dislocation on to the dorsum ilii, which came under the writer's notice, was caused by the squeezing and rolling of a man's thighs and hips between a moving omnibus and a wall, in which position abduction could scarcely have occurred; and Hamilton mentions a case caused by a fall from a height on to the outer side of the knee, where a contusion existed to verify the patient's statement. Tillaux, indeed, avers that adduction, with flexion and internal rotation, will send the head of the bone out below the tendon of the obturator internus, and his belief is that all dorsal dislocations are primarily incomplete ischiatic. In curious contrast to these views are those of R. A. Vance, who asserts that if the acetabulum be divided into 360 degrees, it can be truly said that dislocations occur at every degree. Eve, also, has collected several cases of direct dorsal dislocation; and there is a specimen in St. Thomas's Hospital, in which the head of the femur is seen to have perforated the capsule above the obturator internus tendon.

Since the days of Astley Cooper, who, perhaps more than any other observer, made clear the signs by which the various displacements might be recognised, all surgeons have admitted four distinct forms of dislocation at the hip-joint. These are generally spoken of as—(1) dislocation upwards, or upwards and backwards, on to the dorsum ilii; (2) dislocation backwards, or upwards and backwards, into the ischiatic notch; (3) dislocation downwards, or downwards and forwards, into the foramen ovale; (4) dislocation forwards, or forwards and upwards, upon the pubes.

It is time perhaps that some less cumbersome and lengthy nomenclature was adopted for these injuries, similar to what has now been generally accepted for dislocations at the shoulder-joint; and the writer suggests the terms *superiliac*, *supersciatic*, *superthyroid*, and *superpubic*, to indicate respectively these several displacements. If philologists take exception to these terms, their convenience must be their apology, and they are not more barbarous than those in use for the homologous joint of the upper extremity. These four are usually regarded as the *regular* dislocations of the hip-joint; but others are met with in which the head of the femur occupies various intervening points on the circumference of the acetabulum, and the latter are regarded as *irregular* or *anomalous*. Bigelow has laid great stress on the importance of the ilio-femoral or inverted Y-shaped ligament in determining the character of the dislocation, and he would regard all cases as *regular* except those in which this ligament is 'wholly ruptured.' He also follows Malgaigne in regarding the position of the tendon of the obturator internus as the distinctive feature separating the superiliac from the supersciatic dislocation. In the former, according to these authors, the head of the femur escapes above the obturator internus tendon; whilst in the latter, which Bigelow terms 'dorsal below the tendon,' it escapes below the obturator, and then turns up behind it.

As regards the relative frequency of the four regular dislocations, rather more than half are superiliac, and about a fourth superseiatic; the superthyroid come next in order, and the superpubic are the rarest. The hip is most liable to dislocation between the ages of fifteen and forty-five, and the injury is very much more frequent in males than in females. Several cases have been reported at the age of four years, and one even as early as six months; whilst at the other extreme of life they have been known to occur after the age of eighty.

The Superiliac Dislocation (dislocation upwards and backwards on to the dorsum ilii) may be caused by a fall on the outer side of the knee and thigh, by a wheel passing over the hip, or by a weight falling on the back when the patient is stooping. Malgaigne mentions two cases caused merely by a twist of the limb inwards and forwards.

The *symptoms* are shortening of the limb from one to three inches, adduction, inversion, and fixation. If the patient be examined when standing, the dislocated limb is seen to be semi-flexed and rotated inwards, so that the knee lies above and in front of the other knee, and the ball of the great toe rests on the instep of the other foot. The trochanter is above Nélaton's line, nearer the anterior superior spine of the ilium, and so rotated that its posterior angle projects. The buttock is flattened and the gluteal fold raised. In thin persons the head of the femur may be easily felt, and sometimes be seen, resting in its new position. By increasing the adduction it may be made to project, and during flexion it may be felt to descend. The natural motions of the joint are lost, and the movements are limited to slight flexion, adduction, and rotation inwards.

The ligamentum teres is ruptured, and the capsule often extensively torn, so that sometimes only the upper and anterior part remains unsevered. The untorn portion, nevertheless, has a powerful influence in retaining the bone in its new position; and the maintenance of the inversion is due, according to Bigelow, to the tension of the external fasciculus of the ilio-femoral ligament. Gunn, however, differs from Bigelow on this point, holding that the ilio-femoral ligament is relaxed in superiliac dislocation, and that the continuance of the position is due to the tension of the anterior inferior portion of the capsule and the fascia lata externally. The small external rotators are generally considerably damaged by the dislocation. In one case the head of the bone was found to have escaped between the pyriformis and gluteus medius; in another, between the obturator internus and pyriformis; whilst, in a case related by Cooper, the pyriformis, obturatores, gemelli, and quadratus were all completely torn across. The lower margins of the gluteus medius and minimus may be damaged, and sometimes the psoas and iliacus are partially torn.

If force sufficient to cause dislocation is applied to the limb when extended, the margin of the acetabulum is liable to be split off; but this is not a frequent accident. When it has occurred there has been a tendency to reluxation after reduction.

Reduction of the superiliac dislocation may be effected by *rotation* or *traction*. To reduce the bone by *rotation* the surgeon stands on the injured side, and placing one hand on the knee, grasps with his other hand the leg at the ankle. The limb is then flexed in the adducted position, by which means the ilio-femoral ligament is relaxed and the head of the bone is brought down towards the acetabulum; next, the limb is abducted, then rotated outwards, and finally carried down into the extended position. During this manœuvre the bone usually enters the socket with a sudden snap; but should flexion or abduction be carried too far, the head of the femur may glide round the acetabulum and become lodged in one of the other characteristic situations. Rupture of the outer branch of the Y-ligament, by lengthening the arc, may be another cause of the rotation method failing. An old formula in use at Guy's for many years, was, 'lift up, bend out, and roll out,' which is equivalent to flexion, abduction, and circumduction outwards. Hamilton, in advocating gentleness during reduction by rotation, says 'the limb should follow constantly its own inclination.'

Traction may be made in the extended position by placing the foot on the perineum for counter-extension, and pulling on the dislocated limb, as practised by Morgan and Cock. Traction can also be made, when the thigh is flexed at a right angle to the body, by raising the limb vertically, the surgeon's foot being placed over the anterior superior spine or on the pubes, to make counter-extension. Traction by means of pulleys, as practised by Astley Cooper, is now seldom employed, but, if required, may be applied as follows:—A jack-towel is passed between the thighs and secured to a staple in the floor near the head of the bed, to fix the pelvis and make counter-extension. A leather girth is buckled round the lower part of the thigh, and connected by the cords of the pulleys to a staple in the wall. Extension is then made, by tightening the pulleys, in a direction downwards and across the other thigh.

The Supersciatic Dislocation (dislocation upwards and backwards into the ischiatic notch, or dorsal below the tendon) resembles in many respects the superiliac. On this account some surgeons have grouped these two forms together as dorsal. According to Malgaigne, and, more recently, Bigelow, the distinction between them rests on the anatomical fact that, in the supersciatic, the head of the femur escapes below the tendon of the obturator internus, and then ascends behind it, so as to lie on this muscle or the pyriformis, the obturator tendon serving to hold down the neck and prevent the bone rising to the position of the superiliac. If the patient is examined in the erect position, the limb will be found adducted and inverted as in the superiliac dislocation, but shortened only to the extent of half an inch, or an inch at most. Allis has shown, however, that if both thighs be brought to a right angle with the body, the knee of the affected side will appear much lower. In the erect posture the great toe rests on the ball of the great toe of the other foot, and the knee is in front of the other knee. The trochanter projects less than in the superiliac, and the head of the bone is less evident behind; but in thin subjects it may sometimes be felt a little above the ischial tuberosity. Squires and Hamilton have detected the head of the bone in the sciatic notch by the finger passed into the rectum or vagina. Syme laid great stress on the lordosis which occurs when the limb is straightened; but this is merely the result of the joint being fixed in a state of semiflexion, and occurs whether the joint is fixed by contraction of the psoas and iliacus, by hip-joint disease, or by dislocation. Passive movement is limited to slight flexion and adduction. Flexion is believed to be essential for the production of this dislocation, and, if seen immediately after the accident, the limb may be found in this position strongly adducted across the other; but the weight of the limb in the erect posture causes the head of the bone to rise behind the obturator to the position of the great sciatic notch. Bigelow, contrary to most observers, maintains that inversion is greater in this dislocation than in the superiliac. Reduction has been found difficult and even impossible in some cases. This Sir A. Cooper accounted for by supposing the head of the femur to have become impacted in the sciatic notch; Bigelow attributes the difficulty to the hooking of the head on the tendon of the obturator internus; whilst Tillaux holds that it is due to the untorn portion of the capsule. The head of the bone is not always found resting on the pyriformis and margin of the greater foramen; sometimes it has been found on the spine of the ischium, or even lower. Fabbri attempted to distinguish between these forms, terming the higher 'sacro-sciatic,' and the lower 'ischio-sciatic.' As the head of the bone escapes between the gemellus inferior and the quadratus femoris, the latter muscle is the one more constantly ruptured than any other. Next to it, the gemelli and obturator externus are apt to be lacerated. The capsule is usually torn from the femur at the lower and back part. If the obturator internus gives way, the dislocation may become consecutively superiliac.

Reduction of the supersciatic dislocation by rotation differs but little from that of the superiliac variety; but to disengage the head it may be well to commence by over-adducting and rotating a little inwards, then to flex, abduct, rotate outwards, and extend. Flexion should not be carried to the same extent as in the superiliac, or the head will be brought round into the thyroid foramen. Sometimes, when rotation has failed, by placing the hands under the knee and lifting up the thigh, whilst repeating the manœuvre, the head may be drawn into its socket. If traction is employed by means of pulleys, the direction of the force should be across the middle of the sound thigh, the patient being on his side.

The Superthyroid Dislocation (dislocation downwards, or downwards and forwards, into the foramen ovale) may be caused by a fall with the limb in an abducted position, or by a weight striking the pelvis when the back is bent and the thighs are separated. Abduction is essential for its production. The lower part of the capsule is torn through, the ligamentum teres ruptured, and the head lies on the obturator externus muscle over the thyroid foramen. The pectineus, adductor brevis, and obturator externus are the muscles which suffer most, whilst the psoas and iliacus are put forcibly on the stretch.

The chief *symptoms* are abduction and semiflexion, with apparent lengthening of the limb. When the patient stands on the sound limb, the foot on the dislocated side is carried in advance and usually pointed nearly directly forwards. The body is bent forwards and towards the affected side, either to relieve the tension of the psoas and iliacus, or, as Bigelow would explain, to reduce the flexion of the thigh consequent upon the trochanters being held up by the ilio-femoral ligament after the head has descended. The heel is raised, and the knee separated from the other knee. On the outer side the prominence of the trochanter is lost, and there exists a hollow, bounded anteriorly by the line of the tensor vaginæ femoris; whilst on the inner side the adductor muscles are rendered tense, and by deep pressure the head of the bone may sometimes be felt beneath them. Anteriorly, where normally the soft tissues are supported by the head and neck of the femur, a lack of resistance is felt with the hand; and, behind, the buttock will be noticed to be flattened and the gluteal fold lowered. Pain is felt along the course of the obturator nerve, and the movements of adduction and extension cannot be effected even with external force. Astley Cooper stated the lengthening of the limb to be two inches, but this is mainly due to the oblique direction of the pelvis. The limb being semi-flexed and abducted, and the trochanter tending to drop into the acetabulum, measurement from the anterior superior spine of the ilium to the inner malleolus usually shows a distinct shortening. Thus Malgaigne found a shortening of two centimètres, Rivington half to three-quarters of an inch, and Morris an inch and a quarter.

To *reduce* a superthyroid dislocation by rotation, the limb is first flexed nearly to a right angle with the trunk, then adducted, rotated inwards, and brought into a state of extension. Over-flexion may convert it into a supersciatic or superiliac dislocation, in which case outward rotation may be necessary for its reduction. Traction may be sometimes effectually applied, in the flexed position, by the surgeon carrying the leg over his shoulder, grasping and raising the thigh, whilst the pelvis is held down and the head of the bone is drawn outwards by a band passed between the thighs. Another way, formerly much in vogue, was to place the patient astride a bedpost and draw the dislocated limb inwards. To employ traction by means of pulleys, it is necessary first to fix the pelvis by a broad band around both ilia; a girth is then passed round the inner side of the dislocated thigh and through the loop of the pelvic band. The pulleys are connected to the girth around the thigh, and whilst extension is being made in a direction upwards and outwards, the surgeon passes his hand under the sound leg, grasps the ankle of the dislocated extremity, and draws the limb inwards.

THE SUPERPUBIC DISLOCATION (dislocation upwards and forwards on to the pubes) is caused by violence which forces the limb into a position of abduction and over-extension, such as may happen when a person stepping unexpectedly into a hole falls backwards. The ligamentum teres is ruptured, and the head of the femur, tearing through the capsule on its antero-internal aspect, ascends upon the body of the pubes beneath or internal to the psoas and iliacus. Usually the head lies external to the femoral vessels, but in one case related by Astley Cooper it lay upon the vessels, stopping pulsation in the artery; and in a case observed by Bransby Cooper, and in another by Gosselin, it lay internal to the vessels. The pectineus and adductor brevis muscles suffer most, and the small fleshy muscles behind the joint —the quadratus and gemelli—are usually torn, and the psoas and iliacus may be lacerated.

The *symptoms* are shortening to the extent of about an inch, abduction of the limb, and eversion of the foot generally to a right angle with the other. The trochanter lies in a hollow on the outer aspect of the hip, and is nearer the anterior superior spine of the ilium, the buttock is flattened, and the head of the femur is to be felt as a hard round ball resting upon the pubes. The movements are limited to slight flexion and abduction. Pain and numbness are felt along the course of the anterior crural nerve, and retention of urine more frequently follows this dislocation than any other, owing probably to an inhibitory action excited by irritation of the genito-crural nerve.

Reduction may be accompanied by rotation in a manner similar to that employed for the superthyroid dislocation, but flexion should be carried further. One hand seizing the ankle and the other resting on the knee, the limb is flexed in the abducted position till the knee nearly touches the abdomen; adduction, rotation inwards, and extension of the limb are the movements then successively employed. Reduction by manual extension has been successfully employed by Morgan and Cock with the foot on the perineum for counter-extension. In one of Morgan's cases, whilst assistants made extension on the limb and he made counter-extension with his foot on the perineum, the patient was told to sit up, the surgeon at the same time rotating the limb inwards, when reduction immediately followed. Thus, flexion and rotation inwards were associated with manual extension and perineal counter-extension. Larrey succeeded in one case by carrying the patient's knee over his shoulder, then clasping his hands over the dislocated bone, and pressing it down into its socket. In Astley Cooper's method by pulleys, extension was made from above the knee in a direction downwards, outwards, and backwards, and counter-extension by means of a band between the thigh and perineum; a towel was then passed round the upper part of the thigh, by which means the head was lifted over the edge of the acetabulum.

Irregular or Anomalous Dislocations.—A certain number of dislocations of the hip cannot be strictly classed under the four regular forms described, but it will be found convenient to arrange them for study according as their clinical signs bring them into near relation with the superpubic, superiliac, supersciatic, or superthyroid forms.

Irregular Dislocations allied to the Superpubic.—In some instances, when the general appearance of the dislocated limb resembles that present in the superpubic form, the head of the bone, instead of passing forwards and upwards so as to lie on the body of the pubes or near its junction with the ilium, is found to pass more directly upwards. These dislocations have been classed as *supracotyloid*, and there are several varieties. In some instances (adspinous) the head of the bone lies just internal to the anterior inferior spine of the ilium, as in cases reported by Morgan, Olknow, and Agnew. In others (abspinous) the head lies on the ilium just external to the anterior inferior spine. In several (supraspinous) the head has been found lodged above the inferior spine, between it and the superior, as in cases reported by Cummins, Lente, and Travers. Lastly, there are cases (infraspinous) where the head rests on the edge of the acetabulum between it and the anterior inferior spine, as in cases reported by Gerdy, Wormald, and Cruveilhier. In all these cases the limb was in a state of eversion similar to what is met with in superpubic dislocation, but carried, in some instances, to an extreme degree, so that the toes pointed outwards and backwards. There was, in addition, a variable amount of shortening and abduction or slight adduction. Reduction should be accomplished by the same manœuvres as recommended for superpubic dislocations.

Irregular Dislocations allied to Superiliac.—There is no irregular dislocation whose clinical signs would lead to its being classed near or among the superiliac; but experimenters on the dead have supplied us with new forms, which, so far as one can judge from clinical records, have never yet occurred among the living. The 'anterior oblique' of Bigelow is to be made from a dorsal by forcibly adducting and everting the flexed thigh across its fellow. Oldnow's case already referred to, which Bigelow places here, the writer, with the original case before him, cannot but regard as an irregular superpubic. The same will be said of the majority of the so-called 'everted dorsal' cases by those who can free themselves from theoretical considerations of the influence of ligaments and tendons. The marked eversion of the limb is the most important symptom in all these cases, and, what is perhaps even more to the point, in the cases successfully reduced by manipulation, rotation of the flexed thigh inwards was the manœuvre followed by success.

Irregular Dislocations allied to the Supersciatic.—These have been included under the general term *infracotyloid*, of which there appear to be several varieties, some being allied to the superthyroid. The head of the bone has most frequently been detected in a direction downwards and backwards from the acetabulum, lying between the spine of the ischium and the tuberosity. In this position one would expect the dislocation to be associated with much flexion of the thigh and inversion of the limb. This was the case with Wormald's patient, whose thigh was inverted, forming an angle of about 45° with the body, the shaft of the femur crossing the symphysis pubis and being immovably fixed. The head was found on dissection to rest opposite the upper part of the ischial tuberosity above the quadratus, and the obturator internus was torn through. In Kirkbridge's case the symptoms were almost exactly similar, and in both the head could be felt beneath the gluteus maximus. A case reported by Warren, and two dissected by Travers, in which there was inversion of the limb, the writer would include in this category. Reduction should be attempted by abduction and rotation outwards, followed by extension. Van Buren's case, in which there was shortening of an inch and slight eversion, whilst the head was 'obscurely felt in the back part of the sciatic notch,' must be regarded as an irregular supersciatic. It was reduced by extension in the flexed position.

Irregular Dislocations allied to the Superthyroid.—In this category the writer places all those infracotyloid dislocations in which there is abduction, eversion, and lengthening of the limb, whether the head of the bone be found to have taken a downward and forward, directly downward, or downward and backward direction. Those in which the head is found to have passed downwards, or downwards and slightly forwards, may be regarded as incomplete superthyroid, whilst those in which the head is found to have passed downwards and backwards are to be regarded as secondary, though by the term 'secondary' in this instance it may not be necessary to regard the original dislocation as having always been complete. Keate's case may be taken as typical of this latter class. A horse fell back on his rider in a deep narrow ditch, in which position they lay struggling for a quarter of an hour. The thigh was much flexed, much abducted, everted, and elongated, whilst the trochanter was depressed. The head was felt close to, and on a level with, the tuber ischii. A first attempt at reduction threw the head into the thyroid foramen, which the patient recognised as the position in which it was first dislocated; it was afterwards returned to the acetabulum. In Bouisson's case the symptoms were almost exactly the same, and the head was felt in a similar position. In others, with the same symptoms, the head could not be felt. In Roux's case, the limb was lengthened, slightly flexed, and abducted, and the head was felt during flexion above and a little internal to the tuber ischii. In Luke's case, where there was abduction and lengthening without eversion, dissection showed that the head had passed directly downwards.

Dislocation *into the perineum* is a rare form allied to the superthyroid. It has usually been caused by a weight falling on the back when the thigh was abducted. The thigh is fixed at a right angle to the body, and the head of the bone can be felt near the raphè of the perineum, where it lies about opposite the junction of the ramus of the ischium with that of the pubes, and is apt to cause retention of urine by pressure on the urethra. There is a deep hollow in the usual situation of the trochanter, and the toes are sometimes everted and sometimes inverted. Reduction is best effected by vertical traction, when the patient is on his back, at the same time that the head is pushed outwards. In this way the head is usually first carried into the thyroid foramen, whence it may be reduced to its proper cavity.

R. Clement Lucas.

HODGEN'S SPLINT.—The suspension splint, devised by Dr. J. S. Hodgen, of St. Louis, United States, for the treatment of fracture of the femur, consists of a wire framework of such a length as to extend from the hip to a point just beyond the foot. From this framework hang in loops broad strips of cotton-sacking. The injured limb is suspended in this form of cradle, the foot being fixed by a strip of strapping to the cross-bar at the end of the wire-splint. The apparatus, together with the limb, is suspended by means of cords and pulleys, either to a long upright board at the foot of the bed, or to a bar extending high above the patient from one end of the bed to the other. Extension of the limb may be regulated by varying the obliquity of the extending cords, whilst counter-extension is kept up by the weight of the patient's body. This suspending apparatus is far more comfortable than the long, outside splint, as it allows some freedom in the movements of the body. It requires much attention, however, and care has to be often taken to prevent eversion of the foot.

HODGKIN'S DISEASE. *See* Lymphadenoma.

HORDEOLUS. *See* Eyelids, Diseases of the.

HORNS (*Synon.* Cornua cutanea).—Cutaneous horns are far from common; they are usually solitary, but several cases have been recorded in which they were numerous. They may occur on any part of the body, but the face, scalp, and penis appear to be the regions in which they are most commonly met with. They grow slowly, and are unattended with pain unless there is some inflammation at the base, which is marked by the appearance of a red areola; this is sometimes followed by a shedding of the horn, which leaves a superficial ulcer. Under these circumstances the horn is gradually reproduced. Horns vary from half an inch to several inches in length, and are larger at the base than at the distal extremity; they are apt to become dry and twisted, so that they often bear a close resemblance to the horns of some of the lower animals. They grow from the deeper layers of the epidermis, and are made up almost entirely of altered epidermic cells, which have a laminated arrangement. After the horn has been removed, it is a necessary part of the treatment to destroy the base from which it grows by means of caustic.

Robert Liveing.

HOSPITAL GANGRENE is a highly contagious form of acute inflammatory gangrene, of which, in its true form, owing to the improved hygienic and sanitary conditions of our hospitals, we rarely or never get an instance in this country. It is a rapidly spreading disease, accompanied by great constitutional disturbance, which almost invariably proves fatal and is of a most contagious nature, so much so, indeed, that it is occasionally denominated 'Gangræna contagiosa.' There is, nevertheless, a modified form of the disease which occasionally occurs, and sometimes assumes an epidemic form, to which the term 'hospital gangrene' is applied, but which should more properly be termed 'phagedæna,' since it differs in many essential particulars from the true hospital gangrene. It is accompanied by much less constitutional disturbance, is not of so distinctly contagious a nature, and involves little danger to life. It may be regarded as an intermediate condition between ulceration on the one hand, and true hospital gangrene on the other.

The views which have been held as to the *cause* of hospital gangrene are various, but there seems to be no reason to doubt that it is due to some specific virus, introduced into the wound. The experiments of Koch seem to prove that the gangrene is due to the presence of minute micrococci, which, when brought into contact with a wound, induce rapid death and destruction of tissue, by a process of multiplication and excretion of a soluble substance, which has a deleterious action on the cells of the part. These minute organisms do not exist in the blood of the patient, since blood-inoculation from a patient suffering from hospital gangrene produces no effect. It would appear that the growth and multiplication of these minute organisms may be favoured by certain atmospheric conditions, which are set up by overcrowding, deficient ventilation, and a want of proper cleanliness, and in this manner an epidemic outbreak of the disease is brought about.

On account of the resemblance of wounds attacked by hospital gangrene to 'diphtheria of wounds,' many authors have regarded the two conditions as identical; but they appear to differ in many essential particulars. There are not in diphtheria the same swelling and pulpy degeneration of the edges of the wound as are found in hospital gangrene; the disease in the former case spreads by the formation of vesicles at the margin of the sore, which run together and form excoriations, which subsequently become covered with a fibrinous infiltration resembling an eschar. Nor is hospital gangrene known to be followed by paralysis, which is so frequent a sequel of diphtheria. *See* DIPHTHERIA OF WOUNDS.

The exciting cause of hospital gangrene is, no doubt, in very many instances, direct contagion. This has been abundantly proved, not only by the experiments of Koch on the lower animals, but by undoubted instances in which the disease has spread by direct contact from one patient to another, and also where the attendant has inoculated himself from an infected patient by accidentally pricking his finger or otherwise. It seems probable, also, that the flies, which usually abound where a number of sick are congregated together, may be a source of contagion, carrying the poison from one wound to another.

Symptoms.—When a wound is invaded by 'hospital gangrene,' it becomes covered with a thick, ashy-grey, or black pulp. At the same time the sore increases rapidly in extent, and has a tendency to assume a circular form. The edges are sharp-cut, and the tissues become swollen and reddened, and in their turn become converted into a black or grey pulpy material, and in this way the wound increases with enormous rapidity. The discharge is thin, dirty yellowish-green, or blood-stained. The limb becomes swollen and hard. The sloughing mass remains adherent to the parts beneath, though at the same time it shows a tendency to separate at the margins, so that it can be moved to and fro when an attempt is made to separate it. At other times the disease appears to assume more the character of an ulcerative process. There is a rapid liquefaction of the tissues, so that the wound soon presents an excavated appearance, and spreads rapidly. The skin around is swollen and red, and would seem to melt away. There is a discharge of a fetid, blood-stained, seropurulent fluid. Generally the disease, whichever form it assumes, is at first confined to superficial structures, the deep fascia appearing to offer considerable resistance to the spread of the disease to the deeper structures. But after a time this tissue may be perforated, and extensive ravages result; muscles may be implicated, bloodvessels exposed and finally perforated, joints opened, and bones denuded of their periosteum and necrosed.

The constitutional symptoms are usually very severe. The expression betokens great anxiety; the body is bedewed with a cold and clammy sweat; there is a small, quick, and rapidly failing pulse. Pain of a burning, stinging character in the part, and frontal headache, are complained of. The respirations become short and hurried, the heart's action becomes weaker and weaker, and the patient sinks in a few hours. *See* PHAGEDÆNA.

Treatment.—There can be no doubt that when this disease attacks a patient he should be immediately isolated from all his surroundings, with special attendants who should be forbidden to mix with the other patients; and be furnished with special appliances and dressings. Should the disease invade a hospital or ward, it should be evacuated at once.

Abundance of fresh air is essential, and this may perhaps be best accomplished—especially in military surgery—by placing the patients under canvas in the open air. The strictest cleanliness is to be rigorously enjoined, and every precaution taken to prevent the spread of the disease from one patient to another. No sponges should ever be employed, but every material with which the wounds are touched should be burned at once.

An endeavour should be made to prevent the extension of the sloughing by the free application of fuming nitric acid to the wound. It should be carefully cleansed with lint or wool, and the whole surface of the sore, and the edges for some distance around, be freely swabbed with the acid, which should be allowed to remain in contact with the tissues for some minutes, so as thoroughly to soak into them. Opium should be given, and the patient's strength supported by the administration of liberal supplies of stimulants and nourishment. Some surgeons recommend, instead of the application of nitric acid, that the tissues should be freely destroyed with the actual cautery.

Dr. Goldsmith, of the United States, speaks highly of bromine as a local application to arrest the sloughing; and others have recommended carbolic acid, iodine, oil of turpentine, and strong chlorine water with the same object. It frequently happens that more than one application will be required should the patient survive, and the operation should be performed under the influence of an anæsthetic in order to do it thoroughly. T. PICKERING PICK.

HOSPITALISM and HOSPITAL MORTALITY.—For a long time surgeons had been convinced, each one from his individual experience, that the mortality among cases in hospital was excessive as compared with that among patients treated in private. Up to 1870, indeed, many hospitals were almost plague-stricken, especially those of cities; the mortality after all major amputations being 1 in 2–3, and due chiefly to septic disease. The experience of lying-in wards, and of ovariotomies in general hospitals, showed the existence in these of some very fatal influence, for the detection of which the puerperal uterus and the peritoneum seemed to be the most delicate instruments. No attempt, however, was made to reduce to figures the difference in mortality after operations within and without hospital walls until Sir J. Simpson published papers on the subject in 1869.

Before going further, attention should be drawn to the fact that in 1869 small country and cottage hospitals were rare. The frightful mortality above-mentioned was calculated from the statistics of hospitals in the large towns of Great Britain and the Continent, and existed in them only at that time; fortunately such a state of matters is now a thing of the past, and young practitioners know nothing of it.

As the standard of comparison Simpson selected amputations through bones (those through joints being excluded for the sake of simplicity), because their frequent occurrence rendered possible the collection of large numbers of cases both in and out of hospital; the amount of operative skill required put country practitioners and hospital surgeons more on a level in this respect, and the similarity of the causes for which those operations are performed, and of the condition of the subjects of them in hospitals and in the country, justified the comparison of the two series of cases.

From eleven large hospitals in London, Edinburgh, and Glasgow, Simpson collected 2,089 cases of amputation through the bones of the thigh, leg, arm, or forearm; of these, 855 died, giving a mortality of 1 in 2·4 (in each case the statistics included those for 1868 and the preceding years).

Simpson also sent schedules to a large number of practitioners resident in districts where accidents were common, requesting each to record *all* his amputations under headings of 'injury' and 'disease,' in each case noting the number of deaths. The results obtained showed that of 2,098 cases of all kinds, 226 died, or 1 in 9·2.

At least 23 of the cases were double, and of these only 7 died, in 3 of which one thigh, and in 3 both thighs were removed. The mortality even in these cases was only 1 in 3·03. It appeared, further, that of 22 amputations between 70 and 84 years, 8 died, or 1 in 2·7, the mortality being less than that for amputations at all ages in general hospitals. There is every reason to believe that had the operations been done by men of experience, the results would have been better still, for the results of each practitioner improved with the number of amputations performed.

It was evident from the numbers of amputations at different heights, and from remarks appended, that there was no material difference in the severity of cases in the two classes: thus, among the country cases were 313 primary amputations of the thigh, with 80 deaths, or 1 in 3·91; whilst in the hospital list were 304 cases, with 196 deaths, or 1 in 1·57. It is probable, indeed, that the conveyance of these severe injuries to hospitals told considerably against the patients. The remarks showed that many cases included in the country list, and which ultimately did well, were not sent to hospital simply because they appeared so bad that to carry them any distance would have been fatal. Lastly, very few of the amputations in private were done among the upper class of society—8 to 10 per cent. of the whole were done among the middle class, and the vast majority upon artisans, miners, labourers, &c.; so, as regards social position, the two classes are strictly comparable. Much has been made of the probability that the country patients were in ruder health at the time of operation than those admitted into great hospitals; but no inconsiderable proportion of amputations done in London, even, comes from country districts, and feeble constitutions, debauchery, and inattention to domestic hygiene are not unknown in the country. Even in this respect, therefore, the two series of cases do not differ much.

It should be noted that, in the country statistics, Simpson seems to have made all doubtful cases tell against them; e.g. an amputation was said to have done well, but the patient died of phthisis three months later—it was counted as a fatal case.

It may therefore be taken as approximately true that, at the period of which we are speaking, the mortality after amputations for all causes was almost four times as great in large hospitals as in the country. Though no similar comparison of the results of other operations has been made, there is no reason to doubt the truth of the conviction which was widely held, viz. that every patient with an open wound was safer out of hospital than in it, even though he should be placed under circumstances immeasurably inferior as regards surgical skill, nursing, housing, and feeding.

This difference in results led to the belief that certain conditions in hospitals engendered disease, and the word '*hospitalism*' was invented by Simpson to express those peculiarities of hospitals which produced such fatal results. The exact meaning of 'hospitalism' will, however, be found, by comparing the *causes of death* in the two classes, and seeing which produce the excessive mortality in hospitals.

The cause of death was stated in 160 of the 227 fatal private cases; these, at a mortality of 10·8 per cent. among 2,098 patients, correspond to 1,478 patients. In the following table the number of deaths per cent. (calculated upon this number), produced by the chief causes are shown; and, side by side with them, similar results from a series of 200 amputations through bones, with 49 deaths (24·5 per cent.), performed at University College Hospital from 1871 to 1881 inclusive:—

Private—1,478 cases.

Cause	No. of cases	Per cent.
Shock	63	4·05
Internal injuries	13	0·87
Exhaustion	28	1·89
Pyæmia	8	·54
Septicæmia	0	·00
Tetanus	11	·74
Gangrene of stump	18	1·20
Secondary hæmorrhage	9	·60

University College Hospital—200 cases.

Cause	No. of cases	Per cent.
Shock	10	5·00
Internal injuries	1	0·50
Exhaustion	4	2·00
Pyæmia	12	6·00
Septicæmia	9	4·50
Tetanus	0	0·00
Gangrene of stump	3	1·50
Secondary hæmorrhage	0	·00

Other causes in each series produced 1–2 deaths each.

Erichsen states that the amputation-mortality at University College Hospital has been pretty constantly a little above 25 per cent, and although of late years the mortality from septic disease has been much diminished, from the successful employment of antiseptics, other causes have kept up the mortality almost to the same point. Whilst yielding the same total mortality then, the statistics of University College up to 1868 (could they have been obtained) would have brought out still more strongly the chief difference between the above tables, viz. the difference in mortality from septic disease. The best way to arrive at this is probably to add together the mortalities from pyæmia, septicæmia, and exhaustion; for under the latter heading were formerly placed many cases of acute and chronic septic disease. The cases which may fairly be entered under the head of exhaustion will balance each other. We thus find that the mortality from septic disease in private is 2·40 per cent., in hospital 12·5; in other words, the mortality from septic disease in University College Hospital during the last 11 years has been 5·14 times greater than it was among private cases 15 to 20 years ago. And this is not putting the case as strongly as it might be put by any means. The general result of the discussion at the Clinical Society in 1874 on 'pyæmia in private practice,' pointed to a similar conclusion; though it is right to state that a few surgeons, and especially Sir J. Paget (who had seen 3 cases of hospital gangrene in private, at different times and apparently not due to infection from hospital cases), expressed their belief that septic disease was not specially common in hospitals.

Causes of Hospitalism.—Why were septic diseases so much commoner in hospitals than in country cottages? What were the differences in the conditions of the two classes of patients? The first is that private patients were treated apart from each other, in cottages which probably never before contained a surgical case, and by men who may not have had another case with an open wound under their care at the time—certainly not a case of infective wound disease, unless it were erysipelas. Next, the almost constant remark concerning the dwellings in which the patients lived was that the ventilation was of the freest, through broken windows, &c.; they were either one- or two-roomed, and by no means remarkable for cleanliness. The conditions were therefore strongly opposed to infection from any case of wound-disease. But simple putrefaction of the discharges probably occurred in every case, and it is more than likely that, in spite of the draughts, many patients suffered at night from simple overcrowding.

On the other hand large hospitals had for generations contained numbers of septic wounds, and many of the sufferers had died of septic disease, so that any virus which such cases could leave behind them would certainly have been left. The wards were often 'close' from simple overcrowding; and at dressing time, if at no other, an odour of putrefaction arose from the wounds. Isolation of existing cases of septic disease, even erysipelas, was not uniformly practised; and disinfection after the death or recovery of such a case was by no means perfect, if attempted. The same surgeons, dressers, and nurses tended the patients, and in passing from one to the other the hands were not cleansed, unless distinctly soiled. Sponges used promiscuously among the patients were ready carriers of infection. Lastly, when septic disease started in hospitals, the conditions giving rise to it often went long undisturbed and unchanged; thus certain beds maintained bad reputations and added considerably more than their share to the general mortality.

Now, assuming that erysipelas, hospital gangrene, septic infection, and many, if not all, cases of pyæmia are mildly infectious, and certainly contagious or inoculable, no conditions can well be imagined more favourable than the above either to the spread or to the preservation of their seeds. Infection and contagion doubtless explain a great deal of the excessive mortality of hospitals; as is shown by the immediate diminution of mortality in lying-in hospitals after insisting that the nurses should wash their hands in carbolic-water after attending to each patient, or upon causing each patient to attend to herself and to use clean wool (which is immediately burnt) instead of sponges.

It is impossible to say exactly how much of the excessive mortality of hospitals is due to simple infection; but it is held by the majority of surgeons that pyæmia, septic infection, and hospital gangrene actually arose with special frequency in hospitals. *The* condition which chiefly favours them is overcrowding of septic wounds. In civil hospitals again and again the best surgeons have noticed that when the amount of suppuration in their wards rose above a certain point, septic disease broke out. Again, the common experience in times of war is that cases admitted into the hospital at first do well; but ten to fourteen days after a battle, when the hospitals have become crowded with wounded, septic disease appears and empties many a bed; and this in churches, barns, and similar buildings which never held a septic case before. As a rider to this, it must be added that where overcrowding is almost impossible—as in the open, in tents or lightly constructed huts—septic disease is slight or absent.

Thus, overcrowding of wounds does seem to exercise a powerful influence in the production of septic disease. But wounds are not essential, for overcrowding of typhus patients may cause pyæmia to appear among them. Overcrowding first prevents a free supply of air from acting upon the virus of these diseases, pure air diluting and being apparently destructive of such contagia. Next, it greatly lowers the health of patients, by causing them to breathe air containing excess of carbonic acid, and of organic bodies leaving the body by the respiratory and other channels; and it thus acts as a predisposing cause of septic disease, like all weakening influences. Finally, overcrowding would seem to have its effect upon the development of the viruses of these diseases, by means of something arising from the septic wounds in surgical hospitals.

All recent research tends to show that these diseases are due to the action of locally or generally infective organisms. Koch was able to obtain from putrid fluids organisms which produced in mice diseases similar to the pyæmia, septic infection, and hospital gangrene of man; and, as he worked in Wollstein, where it was impossible to obtain material from septic diseases to experiment with, this would mean that the organisms of these diseases exist almost everywhere, and that they find putrid fluids a suitable nidus. But, as the discharges of all wounds in former times became septic, each wound would have contained the poisons of perhaps all three hospital scourges; nothing but conditions preventing their entry from the wound, or their development after entry in the system, would save the patients from dying of them; and the effect of overcrowding would be limited to destroying these barriers by enfeebling the patient. But this is certainly not its sole effect. It seems most probable, indeed, that the causes of pyæmia, septic infection, and hospital gangrene are more numerous—as are all organisms—in great centres of human activity; but that they have to undergo some change, some increase of virulence perhaps, before they can invade the body and produce these diseases. The aggregation of septic wounds tends strongly in some unknown way to favour this development; but it is not essential to it, the development taking place apparently under other circumstances, though much less commonly. It is, however, impossible to speak with any certainty on this matter until the poisons of the diseases have been isolated and their life-history ascertained.

Prevention of Hospitalism.—Until the etiology of septic disease is cleared up, action must be taken on the hypothesis that, in at least 99 cases out of every 100, disease of this type is due to the invasion of the body by micro-organisms from a septic wound.

The first point to attend to is the prevention of overcrowding. The amount of carbonic acid in the air is taken as the index of impurity, the deleterious organic matter from the lungs varying directly with it. Normally air contains about ·4 of carbonic acid per 1,000 cubic feet. If the quantity rises above ·6 the room gets 'close.' To prevent this, it is calculated—from the average quantity of carbonic acid given off by an adult in an hour—that at least 3,000 feet of air should be supplied per hour for each adult; 3,500 to 4,000 feet will therefore be required for a case with a septic wound. This amount must be supplied without draughts, which can be effected only by giving each bed a cubic space of 1,800 to 2,000 cubic feet, the height being about, but not more than, 12 feet. As much space as possible between the beds should be given. Provision must be made for the removal of stale and the supply of fresh air at the stated rate, open windows and cross ventilation being used as much as possible.

Whenever it can be managed, a ward should be emptied and thoroughly cleaned and ventilated for a week after three months' use.

The clothes of patients should not be placed, in their frequently filthy condition, beneath the beds.

Secondly, with regard to wounds, these should be rendered and kept aseptic wherever possible. When this is impossible, no discharge should be allowed to accumulate and decompose in the wound, but it should be drained off and immediately disinfected by the dressing. No one should pass from one case to another without purifying his hands with an antiseptic solution—mercuric chloride, 1 per 1,000, being the best.

Foul cases—e.g. large ulcers, moist gangrene, incontinence of urine or fæces—should not be admitted to the general surgical wards.

Thirdly, should a case of septic disease occur, it should be isolated as soon as recognised, together with bed, bedding, and all belongings; and the ward round about well washed with bichloride of mercury solution (1 in 500) or carbolic lotion. This is especially necessary with erysipelas and hospital gangrene. No communication should take place between the attendants upon ordinary and upon septic cases. The freest ventilation should be provided in the infectious ward.

Upon the recovery or death of the patient, the straw of the mattress should be burnt and the rest of the bedding disinfected thoroughly. The iron bedstead should be taken to pieces and well washed with carbolic or mercuric lotion. If the patient returns to the ward he should first have a bath containing carbolic acid (1 in 40), or bichloride of mercury (1 in 1,000).

None of these precautions should be neglected, but least of all the prevention of putrefaction in wounds, this being so favourable to the development of the organisms of septic disease. Every hospital now-a-days shows the results of antiseptics, though 'Listerism' may not be practised. No more striking example can be given than that offered by Lister himself when introducing the subject. The male accident wards of the Glasgow Infirmary were decimated by septic disease, the surroundings of the hospital being truly awful (*Lancet*, Jan. 1, 1870, p. 6). The mortality among Lister's own amputations was 1 in 2·2; after the introduction of antiseptics it fell to 1 in 6·6 (3 years' experience.) During this time two died of pyæmia, in one of which the disease was contracted before amputation, and in the other the dressing became septic. Here there was absolutely no other change, and the cases were treated by the same hand. Other hospitals, especially some German ones, tell the same story; so that now we have much less use for the word 'hospitalism.'

STANLEY BOYD.

HOUSEMAID'S KNEE. *See* BURSÆ, Affections of.

HOWSE'S SPLINT for excision of the knee is a metal splint roughly resembling McIntyre's splint, but the thigh and leg pieces do not reach so near to the knee, and instead of the hinge behind the joint there is a rigid metal bar about two inches wide. At the distal extremity of the splint there is a pulley which revolves transversely; the limb is suspended from this pulley, which allows rotation of the limb when the patient shifts his position, and so protects the knee from jarring. The limb is fixed to the splint by waxed bandages, and the intervals between the limb and the splint are packed with cotton wool soaked in melted wax and paraffin, which prevents the discharges trickling between the limb and the splint.

BILTON POLLARD.

HUMERUS, Dislocations of the. *See* SHOULDER, Dislocations of the.

HUMERUS, Fractures of the.—Fractures of this bone fall into three groups—(*a*) those of the upper end, (*b*) of the shaft, (*c*) of the lower end. In group (*a*) are fracture through the anatomical neck: splitting off of the greater tuberosity: separation of the epiphysis (a block including the head and the two tuberosities): and, a little lower down, fracture through the surgical neck. These injuries are generally the result of a fall on the shoulder or other direct violence, though they are occasionally produced by falls on the elbow or hand.

Fracture exactly in the line of *the anatomical neck*, if complete, would isolate the head, and might be expected to lead to its necrosis. Such a result, however, in simple fracture, has not been observed, either because separation has not been absolute, or because some of the capsule has remained attached to the upper fragment, and has sufficed to maintain its nutrition. This fracture is often impacted. In some cases the upper fragment is more or less rotated, and has even been found turned round, so that its cartilaginous surface presented towards the shaft, in the cancellous tissue of which it was firmly embedded; or the head may even be driven out through the capsule into the axilla. Exact diagnosis, especially if swelling is great, may be impossible. There may be crepitus, with absence of the signs of fracture in other parts, and loss of free movement between the smooth surfaces of the joint. Occasionally the head is felt not moving with the shaft when the arm is rotated, or the upper end of the bone feels abnormally wide. In impacted fracture there is slight shortening, slight flattening of the shoulder; the smooth movements of the head in the glenoid cavity are not felt; the upper end of the shaft is slightly drawn up towards the acromion.

Fracture of the greater tuberosity has several times been verified by dissection; but the injury is almost invariably associated with dislocation of the humerus beneath the coracoid process. Some, however, maintain that it occurs alone, either from direct violence or from the sudden action of the muscles inserted into this process. For its treatment (after reduction of the dislocation of the head, should this be present), nothing would be required beyond keeping the arm at rest by the side.

Separation of the epiphysis is not met with after the age of about twenty. When it occurs, the head is felt in the glenoid cavity, but it does not rotate with the rest of the bone. The upper end of the shaft is drawn inwards and upwards beneath the coracoid, where its smooth outline, contrasting with the jagged shape of an ordinary fracture, can be felt. The elbow is slightly withdrawn from the side, and pointed slightly backward.

Fracture of the surgical neck is much more frequent than the injuries already mentioned. Its seat may be at any point between the tuberosities and the insertion of the teres major, a space of about two inches. It is generally transverse, and not rarely impacted, the shaft being driven into the upper fragment. The upper fragment is often rotated through a quarter of a circle, or more, by the muscles inserted into and acting with great leverage upon it; the shaft is drawn, by the muscles attached to it, inwards towards the axilla, where its small irregular end, quite unlike the head, may be detected. There may be shortening, but this is seldom marked; there is flattening of the shoulder; the head does not rotate with the shaft unless there is impaction; and crepitus is detected when the ends are brought into contact.

Treatment.—If there is impaction, care should be taken not to break the connection between the fragments. A pad must be placed in the axilla, and the arm, hanging down, must be bandaged to the side, the forearm lying across the chest. When there is no impaction there is great difficulty alike in adjusting the fragments and in maintaining them in position, the more so because swelling is often considerable. Reduction here, as in separation of the epiphysis, may sometimes be effected by carrying the limb perpendicularly over the head, and manipulating the fragments in this position, and then bringing down the arm while extension is steadily continued. After reduction a pad is placed in the armpit, and a splint of leather or gutta-percha is moulded over the shoulder and arm; towards this splint the upper end of the lower fragment is drawn—that is, outwards—by a carefully applied bandage. The elbow is then bandaged closely to the side, so as to throw the upper end of the lower fragment still further outward. Or, as Erichsen suggests, a piece of leather, two feet long and six inches broad, may be bent at its middle and applied, the one half to the chest, the other to the inner aspect of the arm; the rounded bend, which must be carefully padded, being well pressed up into the axilla. The elbow is then bandaged to the side.

Fracture of the surgical neck is sometimes associated with *dislocation of the head* of the bone into the axilla, or forwards under the coracoid process. This injury is easily mistaken for ordinary dislocation. But on careful examination the following symptoms will be detected:—The shoulder is flattened, and a hollow beneath the acromion shows that the head has left the glenoid cavity; the head is felt in its abnormal situation; no movement, however, is communicated to it when the shaft is rotated; the width of the shoulder from before backwards is increased; the arm is shortened, and the upper end of the shaft may sometimes be felt as a rough projection beneath the deltoid. Crepitus may perhaps be detected when the arm is extended and rotated.

Treatment.—An anæsthetic should be given, and, if possible, the head should be replaced in the glenoid cavity by extension and manipulation. The fracture should then be put up in the manner described above. In several recorded cases reduction has been easily effected. Should the attempt, however, fail, the shaft may be pushed up into the glenoid cavity to form a false joint. Or the fracture may be put up with the head unreduced, and when union has taken place an attempt at reduction may be made. This, however, is very little likely to succeed, and all that is possible will be to break down adhesions, and restore some degree of movement, as in an ordinary case of unreduced dislocation. In such instances it is best to give the patient a written statement of the nature of his injury, so that his case may not subsequently be mistaken for an uncomplicated dislocation, and be treated from that point of view.

Fracture of the shaft is more frequent in the lower than the upper half. It is due either to direct violence; to falls on the hand or elbow; or (and this more often than in any other bone except the patella) to muscular violence. The fracture is generally oblique, in a direction downwards and outwards, but not rarely it is transverse. The *symptoms* are plain: loss of power, mobility when the two fragments are separately grasped, and crepitus. In oblique fractures overlapping may be considerable. The deltoid, in fractures below its insertion, may cause troublesome displacement by tilting the upper fragment outwards. Ununited fracture is much more common in the shaft of the humerus than in any other of the long bones.

Treatment.—After adjustment has been effected, four splints of appropriate length, and wide enough in the aggregate to exactly enclose the limb, are applied so as to surround it, and are fixed by broad pieces of strapping and a bandage. The forearm, placed at a right angle, should be securely bandaged across the chest. Some surgeons use a rectangular splint, extending along the inner aspect of the arm and forearm, with three short accessory splints for the purpose of defending the fracture from disturbance by movements of the forearm, which they regard as the chief cause of non-union. Extension (in order to prevent shortening) has been attempted in various ways, among others by applying weight-extension (in the usual manner), but with no very satisfactory result. Union should be firm in from thirty days in the young, to forty or forty-five in older persons, and it must be carefully tested before the splints are discarded. The arm is useful even where union takes place with considerable deformity. The large vessels generally, but not always, escape injury. Paralysis may occur from pressure on the nerves, especially the musculo-spiral, resulting from exuberant callus. *See* NERVES, Injuries of.

Fractures of the lower end are divided into those which are external to, and those which involve the joint—an important distinction in respect to the future utility of the limb. The first group comprises transverse fracture just above the condyles; separation of the epiphysial block; and detachment of either of the condyles. The second group includes T-fracture, consisting of a transverse break just above the condyles, accompanied by a vertical fissure separating the two condyles from each other; and an oblique fracture, detaching a fragment of variable size, composed of one or other of the condyles, and a corresponding portion of the articular surface. All these injuries are much more common in the young than in adults, while separation of the epiphysis does not occur after about the eighteenth year. They are apt, particularly those which directly involve the joint, to be followed by impairment of movement in the limb, a fact of which it is best that parents, at the outset, should be informed. They are usually produced by falls on the elbow, or, more rarely, on the hand.

Fracture across the bone, just above the condyles, may be directly transverse; but it is generally oblique, the line passing upwards and backwards. Occasionally it runs upwards and forwards. The appearances caused by this injury are very similar at first sight to those of dislocation of the bones of the forearm backwards, and the likeness is still more deceptive when the latter accident is combined with fracture of the coronoid process of the ulna. The olecranon projects backwards under the action of the triceps, and the tendon of this muscle stands out in strong relief; the forearm looks shortened, and the lower end of the humerus is prominent anteriorly. A correct diagnosis, however, is easily arrived at. In dislocation the humerus is found to be entire, the two condyles lying, as they should, in the long axis of the shaft, while the olecranon has been separated from them and carried backwards. In fracture of the humerus the condyles are parted from the shaft, and have followed the olecranon backwards. In dislocation there is limitation of mobility, the soft structures are tense, and some force is required to effect reduction, but when this has once been effected it is permanent; while in fracture of the humerus the parts are less fixed and less tense, and reduction is very easily effected, but deformity returns when extension is withdrawn. The same recurrence of deformity is observed when the coronoid process is detached, but the condyles of the humerus are found in their normal relation to the shaft.

Treatment. — In transverse fracture above the condyles reduction is easily effected by drawing the radius and ulna forwards, while the shaft of the humerus is steadied by an assistant. A firm gutta-percha or leather splint, bent to a right angle, is then moulded to the whole length of the posterior aspect of the arm, elbow, and forearm as far as the wrist; and a well-padded short splint is applied to the front of the arm to prevent projection of the upper fragment forward. These are secured by wide pieces of strapping and a bandage. When, as is often the case, there is considerable swelling, the limb must be placed in an elevated position on a pillow, and evaporating lotion used until the appliance referred to can be borne; in the meantime, if there is any marked tendency to displacement, the limb should be secured by light bandaging on an inside rectangular splint. In three weeks, the lower end of the humerus being firmly held, gentle passive movement of the elbow should be employed. The splints may be discarded in from three weeks to a month in young subjects; in adults they should be continued for five weeks.

Separation of the epiphysis must be treated in a similar manner. Displacement is usually slight, and the fragments are easily kept in place by the splints mentioned above. Gentle passive movement should be practised at the end of a fortnight. The tip of the internal condyle is sometimes knocked off by a fall on the elbow, or detached by the action of the muscles arising from it. The fragment can generally be felt to be displaced, and can be moved when grasped. Crepitus may sometimes be detected, and there is pain when the patient attempts to flex the forearm. The separated piece may, in some cases, be maintained in place with strapping and a pad; but even if this cannot be done, ligamentous union occurs, and no impairment of the arm is likely to remain.

Fractures of the lower end of the humerus, entering the elbow-joint, are always serious. It is difficult alike to adjust the fragments and to keep them in position. The contour of the articular surfaces is apt to be permanently changed; and the inflammation which follows the injury leads not only to the formation of articular adhesions, but to the production of a large amount of callus, by which the movements of the joint are in great part or entirely prevented. Usually considerable swelling follows quickly on the accident, and interferes both with exact diagnosis and with the necessary treatment.

In T fracture all these drawbacks present themselves. Not only is there displacement backwards, but the olecranon is apt to be wedged up into the line of fracture between the two condyles, with the result of spreading them from each other and increasing the transverse diameter of the joint. This relation of the fragments to each other it may not be possible to correct, while, especially in young subjects, the callus thrown out from the broken surfaces and the surrounding soft parts converts the lower end of the humerus into a shapeless mass, against which the radius and ulna become firmly locked. At once, or as soon as swelling has sufficiently subsided under the influence of position, rest, and cold lotions, adjustment must, as far as is possible, be accomplished, an anæsthetic being, if necessary, used. To facilitate reduction, the forearm, bent at a right angle with the arm, should be pressed downwards for the purpose of disengaging the ulna from between the fragments, which must then be manipulated in whatever direction is indicated by their displacement. The joint should be placed at a right angle, not only to relieve tension, but in view of the stiffness which is likely to ensue. The most convenient splints are those recommended above for transverse fractures above the condyle; but a rectangular inside splint for the arm and forearm may be used. Any improvement in the position of the fragments that may be possible must be secured by further modelling; but little in this direction can be done after about the twelfth day. Passive movements should be commenced, in children, not later than the twentieth, in adults not later than the thirtieth day, and be regularly continued as long as they are found to increase the range of motion in the joint; but the condition of the fragments, as to their firm union, must first be carefully observed. In some cases movement may be improved at a later period, and when some of the callus has been absorbed, by breaking down adhesions under an anæsthetic; but no great force ought to be employed. Should the joint have become fixed at an inconveniently obtuse angle, there is no objection, if it can be done without much violence, to bending it up to within a right angle. For the diagnosis and treatment of oblique fracture of either of the condyles extending into the joint, the rules, modified according to particular cases, are the same as those just stated for T fractures. Howard Marsh.

HYDATIDS.—In considering this subject from a surgical point of view, attention will be chiefly directed to symptoms, diagnosis, and treatment. It may, however, be well at the onset to briefly recall to mind some of the main features of the pathology.

The formation of an hydatid results from the ingestion of the eggs of the tænia echinococcus—a tape-worm found in the upper small intestine of the dog. The embryo, when liberated in the human stomach by the disintegration of its egg-shell, bores into or through the gastric walls. In the majority of cases it then enters the blood-vessels and is carried by the blood-stream to the various organs and vascular tissues of the body, not one of which is exempt from its invasion. The organ most frequently attacked is the liver; possibly, as Dr. Thomas suggests, because the hepatic capillaries are the first to arrest the onward progress of the embryo. Should it run the gauntlet of these, the pulmonary capillaries act as the obstruction, and consequently the next most frequent seat of the disease is in the lungs. In a fully-formed hydatid three layers may be described as composing the cyst-wall. The outermost layer, called the adventitia, is tough, fibroid, and very vascular. It is not, however, a part of the true hydatid, but is formed of the tissue in which the parasite lies. The minute embryo acts as an irritant, and induces proliferation of the cells of the surrounding connective tissue; as it enlarges, the cells are subjected to pressure, and become arranged round it as a capsule. Blood-vessels from the adjoining healthy tissues enter this capsule, which is thus gradually organised into a fibrous membrane. This adventitious layer varies in thickness according to the amount of initial irritation and the position of the hydatid; in some structures it would appear never to be formed at all. Thus, Professor Allen, of Melbourne, has reported several cases of hydatids in serous cavities perfectly devoid of adventitia. It is, however, usually present, and is always very vascular. The vessels on its smooth, inner surface are dilated and varicose—a fact to be constantly borne in mind by the surgeon.

Within the adventitia, and in close contact with it, is the true hydatid sac. It has a greyish, gelatinous appearance; it is translucent and highly elastic. When punctured, the contained fluid is evacuated under considerable pressure, and the cyst collapses, falling in folds from the adventitia with a peculiar tremulous movement.

The outermost layer of the *true cyst* (ectocyst of Huxley) is tough, thick, highly elastic, and laminated. The inner layer (endocyst or germinal membrane) is thin, delicate, and cellular. The contained fluid, when healthy, is limpid and transparent, and has a peculiar faint and earthy odour. It is neutral or alkaline in reaction, and of low specific gravity, 1005–1013; it contains an excess of chloride of sodium, but no albumen. Some small hydatids consist merely of the cyst filled with this fluid; such are called acephalocysts. In most cysts, however, and certainly in large ones, echinococcus heads or scolices are to be found. Small cysts, termed 'daughter cysts,' are sometimes formed within the main cyst, and these in turn may contain 'granddaughter cysts,' resulting in what is known as the 'pill-box' hydatid.

Symptoms and Diagnosis.—When an hydatid is sufficiently near the surface of the body to be recognised, it appears as a painless swelling, slowly increasing in size, but giving rise to no inconvenience except by reason of its bulk. Occasionally, as a result of pressure on neighbouring structures, or of changes in the cyst, certain symptoms may arise. Thus severe gastralgia, attended with attacks of syncope, has been noticed in cases where a large cyst projected from the under surface of the left lobe of the liver, and possibly pressed on some neighbouring sympathetic plexus. Vomiting and other dyspeptic symptoms may be the result of direct pressure on the stomach. The cyst may be even so large as to encroach upon the thorax and impede respiration. Jaundice, ascites, and anasarca may be induced by pressure on the hepatic duct, vena portæ, and vena cava respectively. When in the lung the presence of the cyst may excite cough, dyspnœa, and hæmoptysis. Again, a cyst may inflame and suppurate, and so become practically an abscess, and be attended by constitutional symptoms. Finally, a cyst may be ruptured by external violence. Such a rupture into the peritoneal cavity is attended with agonising pain and intense collapse; the case probably ending fatally. In the lung the rupture is less dangerous, the cyst or cysts being coughed up, although suffocation is not uncommon from the glottis being firmly plugged in the patient's effort to expel the cyst. Even in cases where the cysts have been successfully expectorated, recovery is often slow, as a more or less severe broncho-pneumonia is apt to supervene.

Physical Signs.—The sensation imparted to the fingers of an expert manipulator by palpation of an hydatid tumour is characteristic, and is often an infallible guide to diagnosis. The tumour presents a smooth, uniform, rounded contour; it is elastic and tense, and not at all tender. Fluctuation may generally be obtained. Percussion elicits a clearly defined area of absolute dulness, and in some cases also the peculiar and characteristic thrill known as hydatid fremitus. This is felt in large cysts filled with daughter-cysts, and is probably produced by the concussion of these with each other.

With regard to the differential diagnosis of hydatids, so much depends upon the situation of the tumour that it would be impossible here to enter into special details. Hydatids in the abdominal cavity may be confounded with hepatic abscess, a dilated gall-bladder, malignant growths, renal cysts, uterine and omental tumours, or aneurism. With all these conditions there is either constitutional disturbance or some special symptom which is never present in hydatids. Hypertrophy of the spleen and hydatid of that organ are sometimes mistaken for each other; but the tough, unyielding feel, and the detection of the splenic notch, especially if the condition be associated with anæmia and dropsy, will help to distinguish the former from the tense, elastic, and even hydatid cyst. From an ovarian monocyst the diagnosis of a very large, thin-walled hydatid is not always easy, as there are many characters in common. Attention to the mode of growth—the ovarian from the flank displacing the intestines upwards, whilst the hydatid generally pushes its way from above downwards—may be of service. The careful examination of the fluid obtained by exploratory puncture should be decisive. Hydatids in the lungs may be confounded with phthisis, pleuritic effusion, localised empyæma, and malignant growths. These, again, are usually distinguished by constitutional symptoms. Dr. Bird, in his work on *Hydatids in the Lung*, enters fully into this matter.

Treatment.—Various drugs, such as iodide of potassium, tincture of kamala, and turpentine, have from time to time been recommended as capable of arresting the progress of an hydatid growth or of killing the parasite; electrolysis, also, has been much lauded. The success of these remedies, however, appears to be equivocal; the curative treatment of hydatids is to be regarded as a purely surgical matter.

The disease sometimes undergoes natural cure. The hydatid itself is non-vascular, and derives its nourishment by a process of imbibition from the vessels of the adventitia; this may undergo contraction, and the calibre of its blood-vessels is diminished to such an extent that the hydatid dies from gradual starvation. The adventitia goes on contracting, and sometimes becomes cartilaginous, or even calcareous in places.

Occasionally the daughter-cysts proliferate to such an extent, and become so tightly packed inside the parent cyst, that they are, so to speak, crushed to death. They then degenerate, become opaque, and fuse into a solid mass, which may caseate. These processes, however, are so slow that the life of the hydatid is as a rule longer than that of the patient. The treatment of an ordinary hydatid of moderate size, when possessed of an adventitia, and situated in the substance of an organ such as the liver, spleen, or lung, consists in tapping the tumour with a long, fine syphon-trocar; the fluid is drawn off, and the canula is removed when the cyst is nearly emptied. The result of this procedure is that the hydatid cyst collapses and falls away from the adventitia, and serum exudes from vessels to fill the space thus formed. This fluid is usually absorbed in a few days, and the adventitia then gradually contracts. The cyst may or may not undergo degeneration. The writer, when examining the bodies of persons who had died from other causes, years after being tapped for hydatids, has found cysts almost unchanged, lying simply folded up inside a cavity, and still remaining within the adventitia.

The simple operation described above is, as a rule, free from danger; now and then, however, alarming symptoms supervene. A few precautions are necessary to diminish the risk of their occurrence:—the trocar used should always be a clean and long one, with an accurately-fitting canula; the cyst may be much deeper than the surgeon thinks, and, if the trocar be long enough only just to reach the sac, it may push the adventitia away from surrounding tissue, and so entail an extravasation of hydatid fluid and blood. Some surgeons prefer to use the aspirator; but this involves the risk of exhausting the receiver to such an extent that the dilated vessels of the adventitia may be ruptured, and a dangerous and even fatal hæmorrhage may follow. In tapping a pulmonary hydatid the course of the large bronchi should, as far as possible, be avoided; this is best done by introducing the trocar at the side of the thorax midway between the sternum and spine, and keeping it as nearly as possible parallel with the direction of the main bronchi. The simple introduction of a trocar deeply in the epigastrium has at times been followed by intense shock and collapse lasting for days, probably from some injury to the solar plexus. Slight febrile disturbance occasionally follows the tapping; and, when the operation is performed on an abdominal hydatid, a mild attack of urticaria, known as the 'hydatid rash,' may supervene. This is the result of the extravasation of a little fluid into the large serous cavity; the rash generally subsides on the second day. Occasionally it is necessary to tap two or three times before the parasite succumbs. Inflammation and suppuration of the cyst may follow the operation; they must be met by active treatment. Cases of hydatids in the pleural cavity require careful watching after tapping. Should the temperature rise and the area of dulness suddenly increase, a free incision must be made into the cavity, and thorough drainage established until all cysts and débris are evacuated.

When a cyst has very thin walls, and is freely movable in the abdominal cavity, tapping may prove a dangerous procedure. In these cases there is a probability of the adventitia not being properly formed, and when tapped the fluid is not only liable to be extravasated into the peritoneal cavity, but the collapsed cyst itself may die from malnutrition, and determine a fatal peritonitis.

The plan of treatment the writer has found most successful in these cases is to secure adhesion between the visceral and parietal layers of the peritoneum prior to tapping. This is accomplished by inserting about a dozen harelip pins, with flat heads, through the abdominal parietes into the tumour in a circle round the site of puncture, and then carefully supporting the abdominal walls with strapping or a bandage. At the expiration of from eight to ten hours these pins are removed, the tumour tapped with a fine syphon-trocar and canula, the patient being kept at rest in bed for some days subsequently.

When the cyst is very large adhesions may exist, and the tumour can then be tapped in the ordinary way. But this simple treatment will seldom be successful in such cases, especially if daughter-cysts be present; the sac will require free incision and drainage. This is best performed as follows:—A suitable site for tapping having been selected, adhesion is obtained between the opposed serous surfaces by the use of harelip pins in the manner already described. Then an incision of an inch or more in length is made through the skin, and a full-sized trocar, such as is used in veterinary surgery, is plunged into the tumour, the canula being left in and secured with tapes. The fluid, cysts, and débris are allowed to flow away, and the cavity is washed out twice a day with a tepid antiseptic solution. On the third day the canula is removed and a large india-rubber tube is inserted in its place.

The opening thus made is gradually dilated until the finger—which is by far the best kind of probe—can be easily introduced into the cavity. By this method daughter-cysts, and in some instances even the mother-cyst, may be removed. A very convenient aid is a light steel hook attached by a spring to the pulp of the index finger. These cases are often tedious, the suppuration being sometimes profuse before the mother-cyst and débris have entirely come away. The patient's strength requires support by nourishing and easily-digested food and by fresh air. In the end these cases usually do well.

When a cyst is very large, and movable in the abdominal cavity, possessing but few adhesions and appearing to contain many daughter-cysts, the safest mode of treatment consists in the entire removal of the whole tumour by abdominal section. This operation is generally a complete success. A suppurating hydatid must be treated like an ordinary abscess. Adhesions will generally exist, but if not they must be established, and then the cavity may be freely opened and drained.

When an hydatid in the substance of the liver has been treated by drainage, a biliary fistula is occasionally established which it is difficult to close. The writer in such cases has had good results from the use of the galvanic cautery, a coil of platinum wire, properly insulated, being introduced into the fistulous track.

To sum up, the surgical operations required for the cure of hydatids are four in number, and may be classified thus:—

I. For moderate-sized cysts in solid organs, the minor operation of simple tapping with a fine syphon-trocar.

II. For movable cysts with thin walls, the medium operation of establishing adhesions, drawing off the fluid, and removing the canula.

III. For very large adherent cysts filled with daughter-cysts, the major operation of establishing adhesions at the site of tapping, using a large trocar, washing out the cavity and draining it.

IV. In large movable cysts with partially solid contents—i.e. containing daughter-cysts, and with but few adhesions—the operation of abdominal section and removal of the cyst or cysts entire.

T. Naghten FitzGerald.

HYDRARTHROSIS.—An effusion of fluid into the synovial cavity of a joint, unattended by symptoms of inflammation.

This condition, met with chiefly in the knee, may either result from a previous subacute inflammation, or may from the first be of a passive and indolent character. Usually at the commencement of even the most chronic cases there is slight increase of the temperature of the affected joint; but there is no pyrexia, and pain is absent or very slight. The joint is distended to a degree which makes manifest the reflexions of the synovial membrane; fluctuation can be felt across its cavity, the ligaments are stretched, and there is a feeling of weakness and instability. The contained fluid is of pale yellow colour, slightly turbid, and highly albuminous.

This affection is sometimes the commencement of the joint-disease associated with locomotor ataxy. *See* Charcot's Disease.

The *treatment* will consist of immobilisation, counter-irritation, and pressure.

The limb being placed upon a splint, the joint should be repeatedly blistered. When the fluid has been thus considerably reduced, a layer of cotton-wool should be placed over the joint and an elastic bandage applied; or the joint may be strapped over lint spread with camphorated mercurial ointment.

If, in spite of such measures, the effusion persists, the joint is to be emptied by aspiration, with antiseptic precautions, after which elastic pressure is to be maintained; and, should this fail, the aspiration must be repeated, with the addition of an intra-articular injection. The fluid injected must be aseptic and mildly stimulant. A 1 per cent. watery solution of carbolic acid, or a mixture of tincture of iodine and water (1 in 10), are appropriate injections, though stronger solutions than these are sometimes necessary. The injected fluid having been brought into contact with every part of the synovial cavity, is then withdrawn, the puncture closed, and the joint covered with a layer of cotton-wool and a bandage. The injection is usually followed by a slight inflammation and swelling of the joint, which subsides without treatment, and leaves the synovial membrane with less tendency to excessive secretion.

This treatment is, however, not unattended with danger, from the too great acuteness of the resulting inflammation, and should only be used in otherwise healthy persons. When the use of the joint is resumed support must be given by an elastic bandage.

J. Warrington Haward.

HYDROCELE.—It will be convenient to consider the varieties of hydrocele in accordance with the following classification, and in the following order:—

(1) Acute vaginal hydrocele; (2) Chronic vaginal hydrocele; (3) Congenital hydrocele; (4) Infantile hydrocele; (5) Encysted hydrocele of the testis; (6) Encysted hydrocele of the cord; (7) Diffuse hydrocele of the cord; (8) Inguinal hydrocele; (9) Hydrocele of a hernial sac.

1. Acute Vaginal Hydrocele or acute inflammation of the tunica vaginalis with effusion.

Causes.—The most frequent cause is acute epididymitis, for, owing to the absence of any tough fibrous or other membrane between the epididymis and the subserous tissue of the tunica vaginalis, inflammation very readily and frequently extends from the one to the other. It may be excited by direct injury to the part by blows, squeezes, &c.; by injection of irritating solutions thrown into the serous sac for the cure of a chronic hydrocele; and the use of a dirty trocar and canula in tapping a hydrocele may be followed by acute hydrocele.

Pathology.—The pathological changes resemble those in acute inflammation of other serous membranes. There is considerable engorgement of the veins in the subserous connective tissue, with œdema, which may extend to the superficial structures of the scrotum. The surface epithelium proliferates rapidly, and parts of it become shed in the form of shreddy flakes, and lymph may coat its surface in flakes or in soft, yellow, butter-like masses. The fluid effused into the sac is turbid and very richly albuminous; it is generally in small quantity only. The effusion may become chronic, or, on the other hand, when the inflammation is very acute and not speedily allayed, it may become purulent. Slight or extensive adhesions between the two serous surfaces may be left behind.

Symptoms and Diagnosis.—As most often met with, it causes a moderate, elastic, and fluctuating swelling of the scrotum in front of the inflamed epididymis. The skin over this swelling is reddened and often œdematous. When occurring primarily, there is a moderate globular enlargement of the scrotum, with redness and œdema of the skin and deep fluctuation; the pain and tenderness are not so severe as in inflammation of the testicle, and the cord is not thickened. As, however, the inflammation tends to spread to and affect the epididymis, these distinctions are not often to be observed. The diagnosis rests, therefore, upon detecting an acute inflammatory and fluctuating swelling over the front of the testicle. Should the superficial œdema increase, the swelling 'point,' and the patient experience a rigor or rigors with increased fever, the diagnosis of suppuration in the tunica vaginalis, or pyocele, may be made.

Treatment.—When it is secondary to epididymitis, the treatment of the latter meets the indications. *See* Testis, Diseases of the. When primary, the patient should be confined to bed, with the scrotum raised upon a cushion between the thighs, or a broad strip of plaster stretched across between the thighs; and hot belladonna fomentations should be applied. The bowels, if necessary, are to be cleared by a purge, and the diet should be light and mainly fluid. Tapping should not be performed. Should suppuration occur, the surgeon must at once lay the tunica vaginalis freely open and wash out the cavity with some antiseptic lotion, allowing the wound to heal by granulation.

2. Chronic Vaginal Hydrocele.—*Causes.*—Chronic hydrocele is sometimes secondary to inflammatory and other enlargements of the testicle, such a condition being known as hydro-sarcocele. If we exclude these cases, little is known of the causes of this very common affection. Its frequency in infancy and about middle life suggests that it may be connected with the structural and functional changes occurring at these periods; and when, as sometimes happens, it is seen in several members of one family, an hereditary influence may be inferred. In some cases repeated strains and local injuries appear to occasion the disease, and it has been alleged that hydrocele is especially common in those who are, or have been, the subjects of diseases of the urethra or prostate. In rare instances small loose bodies are found in the tunica vaginalis and are believed to be the cause of hydrocele. The great frequency of the disease in tropical climates supports the view of a malarial origin, and its common association with elephantiasis scroti, when this disease is met with, suggests some etiological factor common to the two. An enfeebled circulation, chronic visceral disease, the dependent position of the scrotum, and relaxation of the dartos, are other alleged causes of hydrocele.

Pathology.—Two views are held as to the nature of chronic hydrocele; by some it is regarded as a 'dropsy,' and by others as an 'inflammatory effusion.' In the author's opinion the evidence appears to support the latter view. The disease occurs about equally on the two sides, and is as often double as single. When double, the effusion is generally later and also less in amount on one side than the other. In children, hydrocele is most common on the right side. The common case is for the tunica vaginalis to be distended into a pyriform or ovoid sac, across which slender adhesions may occasionally be found stretching. But the cavity may be sacculated, and of this three varieties have been noticed. Broad bands of adhesions may divide the cavity into closed or intercommunicating cavities. A pouch is sometimes found extending between the epididymis and the body of the testicle, opening into the general sac on the outer side; this may be regarded as a deepening of the normal digital fossa. The rarest form is that in which a hernial protrusion is found extending outwards into the dartos, this variety being caused by a distension of one of the very delicate, finger-like processes which normally project from the parietal layer of the tunica vaginalis. The serous membrane may remain unaltered in structure even in large and old hydroceles, but more generally its deeper layers are thickened by the addition of newly-formed fibrous tissue, and in some long-standing cases this tissue may attain a cartilaginous consistence, or may become calcified, the lime-salts being deposited in plates or thicker masses. This thickening of the membrane is found to extend over the epididymis, but to a much smaller extent, if at all, over the body of the testicle.

The fluid varies in quantity up to several pints, as much as six quarts having been withdrawn from the historian Gibbon. In adults the average quantity is from six to sixteen ounces. The fluid is of a bright straw colour, sometimes deeper in tint, at others having a greenish hue, and from the admixture of blood (hydro-hæmatocele) it may be rendered opaque and dark. Its specific gravity is about 1024; in reaction it is slightly alkaline. It contains a large amount of fibrinogen, but no fibrin-ferment, and does not coagulate spontaneously unless blood or some other source of the ferment is added to it. A small amount of fatty matter is normally present, and also cholesterine in larger quantity than in any dropsical effusion. Succinic acid is also stated to be present. Fine flakes of lymph, cholesterine crystals, and epithelial cells or shreds may be found under the microscope; and very rarely, larger solid bodies or thick-walled cysts may be found loose in the vaginal sac, these probably being detached hydatids of Morgagni. The fluid may be altered in appearance by the presence of an unusual quantity of cholesterine in the form of sparkling crystals, and, in some cases, the tunica vaginalis has been found filled with a soft solid mass of this substance.

A much rarer condition is the admixture of finely-divided fat, in such quantity as to impart a milky look to the fluid, which retains its turbidity on standing. Where there is a combination of encysted hydrocele of the testis with vaginal hydrocele, the former may rupture into the latter, and, in that case, the fluid may have an opalescent or milky appearance from the admixture of semen; on standing, an opalescent sediment falls, leaving the supernatant fluid clear. The testicle is usually found at the lower and back part of the sac, but when that organ is inverted, it lies at the lower and anterior part; the testicle may be fixed in some unusual position by adhesions. When the quantity of fluid is large the organ is flattened out, and, in old cases, may scarcely project at all into the cavity. As a rule its function is not interfered with, but occasionally the organ is found anæmic and atrophied, and then it probably fails to secrete spermatozoa. The constituents of the spermatic cord are sometimes separated and spread out by the pressure of the fluid in the vaginal sac. The tissues of the scrotum over a hydrocele in time become more or less matted together, and the muscular bundles of the cremaster are hypertrophied, with hyperplasia of the connective tissue making up the cremasteric fascia. In very large tumours of long standing this muscle is apt to atrophy.

Symptoms and Diagnosis.—The main symptom of chronic vaginal hydrocele is the scrotal swelling which it occasions; this leads to a sense of weight in the groin which the patient endeavours to relieve by wearing some form of suspensory bandage; when of large size the swelling impedes free motion, and forms an unsightly prominence difficult or impossible to conceal. A more serious effect is that it renders the part liable to injury, and, owing to the distension of the vaginal sac, the force of contusions is transmitted directly to the testicle, and in this way hæmatocele may be superadded. As the scrotum becomes distended, the skin of the penis is gradually drawn over the swelling, and the penis proper is lost in the scrotum, the glans being at the bottom of an umbilicus-like depression. This is generally a source of much annoyance to the patient, and the trickling of urine over the scrotum may excoriate the part. It is often noticed that the swelling is larger at night than in the morning. When the effusion accumulates with unusual rapidity, or the sac is very tense, or when the part has been contused, or the testicle is inflamed, or blood has been effused into the vaginal sac, the patient may experience acute pain. All the symptoms of hydrocele are much exaggerated when the affection is double.

The tumour, which grows from below, is limited to the scrotum, and the cord can be felt quite free above it. Usually pyriform in shape, it may be ovoid, globular, or may present a circular constriction about its centre. Its surface is smooth, and the tension of the swelling is uniform, but variable in degree in different cases. Fluctuation is to be detected quite across the tumour, which is also translucent. There is no impulse on coughing, and the swelling is entirely irreducible into the belly; the skin over it is not adherent to the deeper parts. The position of the testicle should always be made out; it can be determined by noticing an increased resistance to pressure at one part, by the patient experiencing the peculiar 'testicular pain' when the organ is manipulated, and by observing that at this part too the tumour is opaque to transmitted light. Where all these signs are present the diagnosis is quite easy and certain, but when the sac or its coverings are greatly thickened and opaque, or the contents are opaque or reduced to a solid mass of cholesterine, or a hernia or some other swelling is superadded, the diagnosis may be very difficult or even impossible without an exploratory operation.

From hernia, hydrocele is to be distinguished by its growth from below instead of from above, by its irreducibility, fluctuation, and translucency, and also by the fact that the cord and the inguinal canal are free. When there is a hernia with hydrocele, the distensile impulse on coughing may be transmitted from the hernia to the hydrocele; after reduction of the hernia the hydrocele-swelling will present all its usual characters. Should the hernia be irreducible, the diagnosis becomes more difficult, but the history will probably throw light upon the case; the difference in outline, tension, and consistence of the upper and lower parts of the swelling, the absence of fluctuation and translucency in the upper part, which may be tympanitic on percussion or present the lobulated feel of omentum, and lastly, the extension of the swelling up to but not beyond the internal abdominal ring, are the signs by which this condition is to be recognised. (For hydrocele extending up to or beyond the internal abdominal ring, see *Infantile Hydrocele.*) The chronic character of the swelling, its uniformity, fluctuation, and translucency, together with the detection of the testicle at one part of it, will distinguish hydrocele from malignant tumours of the testicle. From hæmatocele the diagnosis of hydrocele is made by the difference in the mode of origin of the tumours, and usually by the translucency of hydrocele. When a doubt exists, an exploratory puncture will usually clear up the case, but a better plan is to make an incision with antiseptic precautions carefully down into the tumour; this affords more information, and also is the best means of curing the cases which present this difficulty in diagnosis.

Fluctuation and translucency are thus seen to be two very important signs of hydrocele. Fluctuation in scrotal tumours is best detected by grasping the mass with the fingers and thumb of each hand, and then, when compression is made with one hand, the part of the tumour grasped by the other will be felt to become more tense. To test for translucency it is necessary to have a good light, to grasp the tumour properly, and to carefully shut off the rays of light passing over the scrotum. The light should be held on the outer side; the swelling should be seized from behind and made tense in front, and neither the surgeon's fingers nor the patient's penis should be allowed to intercept the rays of light; a stethoscope or some larger tube may be used to look at the part, or the external rays of light may be shut off by the surgeon's other hand. When translucent, a more or less intense reddish glare is seen, the testicle appearing as a dark shadow.

Treatment.—In infants spontaneous cure is not very rare, and the surgeon may fairly wait for a time to see whether it will occur; it is generally thought that the use of an absorbent lotion containing acetate of ammonia and iodide of potassium, or painting the scrotum with diluted tincture of iodine—1 to 3 of spirit—may aid this process. Should it not occur, acupuncture is generally sufficient to bring about a cure, and in the rare cases which resist this measure, injection of the sac must be resorted to. In adults spontaneous cure does, very rarely, take place as a result of injury, but the surgeon should never expect it, and if the swelling is of such a size as to cause annoyance to the patient or is increasing, he must adopt some treatment. Tapping the hydrocele should be first performed, which affords immediate relief; in some few cases it results in cure, but in the great majority it is followed by more or less rapid re-secretion of the fluid. When the fluid accumulates very slowly and causes only trifling inconvenience, or when the patient is aged or the subject of serious visceral disease, the repetition of this trifling operation is the proper treatment. But in other cases when tapping fails to cure, and the inconvenience caused by the affection is marked, and the state of the patient does not afford any sufficient contraindication, a radical cure must be attempted. Many methods have been suggested, but two only—injection of a stimulating fluid and incision of the serous sac—are now practised; the use of setons and caustics has been rightly abandoned. Of the two methods, that by injection is more generally employed; it has the advantage of simplicity and, when carefully done, of safety; but it is liable to failure or to be followed by recurrence of the disease. Incision requires to be done with careful antiseptic precautions; but it is then a safe operation and certain in its results. It should undoubtedly be resorted to when injection has failed, when the sac is considerably thickened or contains loose bodies, when the hydrocele is compound or sacculated or combined with encysted hydrocele, when there is doubt as to the diagnosis, and in the case of aged persons in whom the operation of injection presents special danger.

(1) *Acupuncture.*—The object of this procedure is to allow the serous fluid to leak out into the cellular tissue of the scrotum, whence it is very readily absorbed. An ordinary sewing needle may be employed, but a harelip pin is the best instrument. The swelling being made tense, the needle is thrust obliquely into the sac, and then, without withdrawing it through the skin, the needle is made to puncture the tunica vaginalis in three or four places—not by its point but by the edge of its lance-shaped end. A little fluid generally trickles from the skin-puncture.

(2) *Tapping a Hydrocele.*—For this purpose the common hydrocele trocar and canula is much the best instrument. The surgeon should be careful to have the trocar sharp, the canula well-fitting, and the whole scrupulously clean. The patient may stand with his back against a wall; but should he be nervous, very old, weakly, and liable to faint, or when the hydrocele is very large, he should lie on his side at the edge of a couch. Care must be taken to enter the serous sac without pushing it before the instrument, and not to allow the sac to slip over the end of the canula when it retracts as the fluid escapes; and the surgeon must guard against wounding the testicle, cord, or one of the scrotal veins. Having accurately determined the position of the testicle, a spot is chosen on the opposite side of the scrotum, towards the lower part of the swelling and where the skin is free from visible vessels. With the left hand the scrotum is grasped so as to make the skin and the swelling as tense as possible at this part, and then with the right hand the well-oiled trocar is thrust into the sac; as soon as the instrument is free in the cavity, its point should be directed upwards parallel with the cord, and the canula alone should be pushed in for its whole length. Some surgeons prefer to insert the instrument by steady continuous pressure, while others resort to a quick thrust; each method has its advantages and defects.

The slower method is said to be less painful, and free from risk of injuring the testicle or cord, but the danger of displacing the tunica vaginalis is greater, and therefore this plan should only be adopted when the sac is tense. The more rapid method is free from this danger, but exposes the patient to some risk of puncture of the testicle or of a spermatic vein, unless skilfully performed. The best safeguard is to hold the instrument with the forefinger placed half an inch from its extremity, so that it cannot be plunged in too deeply, and if at the same time the thumb-nail is held behind the broad flange of the canula, it can slip this on over the end of the trocar as soon as the sac is pierced, and while the whole hand is depressed, so as to direct the point of the instrument up along the cord. All the fluid should be removed, the last few drops being gently pressed out; the testicle will be found tender in recent cases. On withdrawing the canula a dossil of iodoform wool should be placed over the skin-puncture, and the scrotum supported in a suspender; the patient should be directed to keep quiet in his room for the remainder of the day.

(3) *Injection of a Hydrocele.*—A favourable time should be chosen when the patient is in good health, and the tumour contains about six ounces of fluid, and the testicle is not tender. It should then be tapped in the usual way, care being taken to push the whole length of the canula into the tunica vaginalis. By means of a well-fitting syringe a stimulating fluid is thrown into the vaginal sac, and the canula is then carefully withdrawn so as not to allow any of this fluid to escape into the superficial tissues of the scrotum. The best form of syringe is one with a long metal nozzle which fits the canula, and when passed in to its full length just projects beyond the end of the canula; by using this syringe the surgeon may be sure of injecting all the fluid into the tunica vaginalis. Many fluids have been used. The most popular, and one which rarely fails, is a solution of 40 grs. of iodine and 30 grs. of iodide of potassium in an ounce of water, of which from 1 to 2 drachms are to be injected. In children the fluid should be diluted one half. Some surgeons prefer the tincture of iodine, B.P., or that diluted with an equal bulk of water; after injection and thorough manipulation of the part, some operators prefer to allow some of the fluid to escape before withdrawing the canula. The operation may cause little or no pain, or be attended with severe pain and great tendency to syncope. Similar differences are seen in the subsequent course of the cases. Generally the injection is quickly followed by a moderate effusion of fluid, with slight redness and tenderness of the scrotum and trifling pyrexia; these symptoms gradually subside, and the fluid is absorbed. But in some cases the inflammation assumes a severer grade, and it is necessary to keep the patient at absolute rest, on spoon diet, and with hot belladonna fomentations to allay the local inflammation. In yet other cases the injection fails to excite sufficient inflammation, and then the surgeon has to manipulate the part freely and let the patient walk about, to try by these means to supplement the irritant action of the iodine. If the fluid at first poured out is not afterwards absorbed, the scrotum should be strapped. The injection sets up a subacute or acute hydrocele, and when the products are absorbed the cavity of the tunica vaginalis, as a rule, is not obliterated, although limited adhesions may form. Iodine may fail to excite sufficient inflammation, or the fluid poured out may not be reabsorbed, and in some cases the sac may be too dense to collapse. On the other hand, if used too strong, it may set up suppuration.

Recently, injection of pure carbolic acid, with just sufficient water added to liquefy the crystals, has been practised. From ♏v–x. is the amount required. The operation is almost if not entirely devoid of pain, and the subsequent inflammation appears to be more uniform in degree than when iodine is used. The author has used carbolic acid in many cases, and with some success; it is certainly less painful than iodine, and he has found it quite unnecessary to confine his patients to bed afterwards; often they are able to go about their work as usual. The acid should always be injected with the long-nozzled syringe. Port wine, chloride of zinc solution, and many other fluids have been recommended and used, but they none of them are equal in value to iodine or carbolic acid. Latterly, finely-powdered iodoform has been introduced into the cavity of the tunica vaginalis, and this practice is highly spoken of; the writer has had no experience of it.

(4) *Incision of a Hydrocele.*—For this the scrotum and pubes should be shaved and thoroughly cleansed, and, using all the usual antiseptic precautions, the surgeon should make a vertical incision two inches long over the front of the swelling. After arresting all hæmorrhage from superficial vessels, the tunica vaginalis is to be opened

for the same length and the fluid allowed to escape. The cut edge of the serous sac is to be united to the skin by one or two chromic catgut stitches on each side, and a drainage-tube is to be passed in to the bottom of the cavity. Outside, the usual carbolic gauze dressing is to be applied. The dressing will need to be changed every third or fourth day, and the tube is to be shortened from time to time, and removed altogether as soon as the discharge is reduced to a few drops. The patient may generally be allowed to get up at the end of the second week. The operation is followed by very slight pyrexia, and slight orchitis for the first two or three days. As the serous cavity is obliterated by this treatment, the cure of the hydrocele is certain and permanent.

3. CONGENITAL HYDROCELE.—*Etiology.* The cause of this variety of hydrocele is a congenital malformation; the processus vaginalis is not obliterated, the tunica vaginalis being therefore continuous with the general peritoneal cavity. Nothing definite is known of the cause of this malformation; it is said to be more common in weakly children and in those born prematurely.

Pathology. — The communication between the tunica vaginalis and the peritoneal cavity may be very free, or it may be valvular or reduced in size until it only admits fluid to flow along it drop by drop; and this constriction may be at one point only—either at the internal abdominal ring or just above the testicle—or involve some length of the serous tube. Congenital inguinal hernia is often associated with it. It may be unilateral or bilateral.

Symptoms and Diagnosis.—The swelling, which is most often noticed in early infancy, has the general characters of hydrocele, being fluctuating, translucent, and surrounding the testicle. In addition, it exhibits a distinct expansile impulse on coughing or crying, and is wholly reducible into the belly without occasioning any intra-abdominal tumour. This reduction is never accompanied with a 'slip' or 'gurgle'; when the communication is free, it is rapid, but when narrow, it is very slow and easily overlooked unless great care be taken and the attempt to reduce it be continued for some few minutes; and this precaution must be observed in every case of hydrocele in infants and young children. When the serous tube is irregularly constricted for some distance, the flow of fluid along it may be attended with a fine fremitus. Should the upper part of the swelling be opaque, or tympanitic on percussion, or yield a gurgle on manipulation, or recede with a sudden slip during taxis, a congenital inguinal hernia is present; a combination of two or more of these signs will render this diagnosis more obvious. Whenever the swelling can be seen or felt to extend along the inguinal canal, or is found to yield a very marked impulse on coughing, hernia is to be suspected.

Treatment.—A well-fitting truss should be applied, to prevent the descent of a hernia, and to induce obliteration of the vaginal process of peritoneum. When this is obtained, the remaining hydrocele can be treated like an ordinary chronic hydrocele. Should obliteration not result—a rare event —and further treatment be necessary, the sac may be injected with the iodine solution, or, better, incised and drained antiseptically. When hernia is combined with the hydrocele, the treatment must be directed to secure the radical cure of this condition, by ligature of the neck of the sac and suture of the inguinal ring if it be dilated.

4. INFANTILE HYDROCELE.—Under this name are known cases of vaginal hydrocele which involve more or less of the process of peritoneum in front of the cord, but are shut off from the peritoneal cavity by obliteration of the tube at or near the internal abdominal ring. The majority of cases of hydrocele in infants are of this nature, and it is rare to find this affection in adults. In men, however, the upper part of the sac may be distended and even form a tumour of large size behind the belly-wall but outside the peritoneal cavity.

Symptoms and Diagnosis.—If the swelling extend up to, but not through, the external abdominal ring, its shape and extent are the only features peculiar to it. Should the sac reach up along the cord in the inguinal canal, there will be an expansile impulse on coughing, but the tumour will be entirely irreducible. In the rare cases in which a sac or pouch is formed within the belly, this internal tumour will be felt, and fluctuation will be detected between it and the scrotal swelling, the one becoming more tense as the other yields under pressure. This simulates reducibility of the scrotal swelling, but the detection of the internal tumour and its increased tension as the scrotum is emptied, will distinguish the case from congenital hydrocele: in such cases there is, of course, a well-marked impulse on coughing.

Treatment.—The application of absorbent lotions or of weak iodine paint to the scrotum should first be tried, and if these fail, acupuncture will usually succeed.

Should a case resist this means, injection with iodine or incision should be practised. Care in the diet and general hygiene of the child may aid in the cure, and, where indicated, tonics should be given.

5. Encysted Hydrocele of the Testicle.—*Pathology.*—Three varieties of hydrocele in connection with the testicle, in which the fluid is not contained in the tunica vaginalis are met with. The most important are cysts in connection with the epididymis — generally the upper part—globular or lobed in outline, and rarely attaining a large size. They consist of a delicate fibrous membrane, lined with tesselated epithelium. The fluid is transparent and colourless, containing a small trace of albumen, chloride of sodium, and alkaline carbonates which give effervescence on the addition of acetic acid. In a certain number of cases the fluid is opalescent or milky in colour, and on standing yields an opaque sediment, consisting of spermatozoa, which may be found moving actively, motionless, or broken up. As the cyst enlarges the vasa efferentia are spread out over it, and it is by the rupture of one or more of these tubes into the cyst—sometimes from injury—that the semen finds entrance to the hydrocele. Such cysts are usually single, they may be multilocular, but are very rarely more than two or three in number. A very unusual condition is for such a cyst to extend up along the cord even to the groin. These cysts have been supposed to arise from dilatations or ruptures of the vasa efferentia, but it is more probable that they are dilatations of the remnants of fœtal structures, particularly of the organ of Giraldès, and the duct of Müller, possibly also of the vas aberrans of Haller. The second and very rare variety is a cyst beneath the tunica albuginea testis, pressing the seminal tubes aside. This condition probably ensues upon parenchymatous hæmatocele. *See* Hæmatocele. The third variety consists in the development of small subserous cysts, the size of peas or currants, in connection with the head of the epididymis; they are common after forty years of age, very rare before that, never contain spermatozoa, and are of no clinical importance.

Symptoms and Diagnosis.—Only the first of the three varieties named above will be considered. The cyst forms a tense globular or lobed tumour attached to the epididymis, and generally situated above and behind the testicle. This tumour is translucent, fluctuating, very movable in the scrotum, without impulse on coughing, and quite irreducible by pressure. The growth is slow, and the tumour is usually painless, and may remain stationary. When of small size the fluid is clear; when larger, it is very frequently mixed with semen. An enlargement occurring suddenly, or following upon an injury, may be assumed to indicate a rupture into the cyst of a seminal tubule. The affection is most common in boys and young adults. Encysted hydrocele may be associated with vaginal hydrocele, and the cyst may rupture into the tunica vaginalis. The diagnosis of hydrocele will rest upon the fluctuation in and translucency of the tumour; the variety of hydrocele will be recognised from the tumour being fixed to but not surrounding or obscuring the testicle, by the small size and globular shape of the cyst, together with its slow growth and the character of the fluid.

Treatment.—When the cyst attains any size or gives rise to annoyance, it should be tapped, the trocar being introduced from the outer side. Should this fail to cure, the surgeon may attempt the radical cure—either by injection of iodine, by a seton of threads soaked in tincture of iodine, or by antiseptic incision. Injection often fails. Incision is readily performed and very certain in its results, and is therefore the best treatment for the cases in which tapping is insufficient.

6. Encysted Hydrocele of the Spermatic Cord.—This is a circumscribed collection of serous fluid in connection with the cord. The cyst is generally developed by distension of an unobliterated part of the vaginal process of peritoneum. Some cysts may be of new formation or dilatations of the organ of Giraldès.

Symptoms and Diagnosis.—The affection is relatively frequent in boys and young men. The tumour is of small or moderate size, ovoid in shape, and attached to the cord; it fluctuates, is translucent and irreducible, but very movable up and down with the cord; its outline is always well defined. If situated in the inguinal canal it is impossible to test for translucency, and the swelling will expand on coughing. By making traction upon the testicle the mobility of the tumour is greatly lessened.

Treatment.—This is the same as for chronic vaginal hydrocele. In the first place absorbents may be tried, and, should they fail, acupuncture, tapping with a trocar, injection with iodine and antiseptic incision may be relied upon in order of merit and safety. Before applying any means of radical cure, great care must be taken to determine that the sac does not communicate with the peritoneal cavity by a narrow channel; such a condition has been called the *water-bottle hydrocele.*

7. Diffuse Hydrocele of the Cord, or œdema of the areolar tissue of the spermatic cord, is a rare condition, the causes of which are not understood. The writer has seen it follow wearing an ill-fitting truss. The spermatic cord is uniformly enlarged, the swelling being elastic, yielding to pressure, with impulse on coughing, but neither fluctuating nor translucent. The tumour may attain a very large size. It is to be distinguished from a hernia by the less clear definition of the swelling, its dulness on percussion, irreducibility into the belly, absence of gurgling, the less clear impulse on coughing, and its smooth contour. Where there is doubt in the diagnosis, a careful incision should be made into the part.

Treatment. — Acupuncture, or tapping with a trocar, may first be tried, and if the fluid reaccumulate, an incision with antiseptic precautions is the best means of obtaining a radical cure.

8. Inguinal Hydrocele. — This is a very rare condition, caused by the accumulation of fluid in a closed serous sac around a testicle retained in the inguinal canal. The cause of the effusion is the injury to which the organ is exposed in its abnormal position. Part of the swelling may escape through the external ring and extend transversely along the groin in the superficial structures.

Symptoms and Diagnosis.—There is a fluctuating, translucent, irreducible tumour in the groin, and the scrotum on the same side is found undeveloped and not containing a testicle. In the recorded cases there is stated to have been no impulse on coughing.

The *treatment* consists in a free incision into the tumour, the removal of the testicle and the careful dissection out of the serous sac. By this means the hydrocele is radically cured, and the patient is freed from the annoyance and risk attending imperfect descent of the testicle.

9. Hydrocele of a Hernial Sac.—By this is meant an effusion of serous fluid into the sac of a hernia, which has become shut off from the peritoneal cavity by plugging of its neck with omentum, or its obliteration as the result of wearing a truss. The disease is more common, and attains greater magnitude, in inguinal than in femoral hernia. The fluid resembles in character that of chronic vaginal hydrocele.

The *symptoms* will be those of a fluctuating, translucent, irreducible swelling, occurring at the site of an old hernia for which, usually, a truss has long been worn. If scrotal, the swelling will reach up to or even into the inguinal canal, and in the latter case will have a faint impulse on coughing. The testicle will not be lost in the swelling as in vaginal hydrocele, nor attached to the cyst as in encysted hydrocele.

The *treatment* consists first in tapping the tumour, and, if this fail to give permanent relief, an incision with antiseptic precautions will be the best means of obliterating the sac. A. Pearce Gould.

HYDROCELE OF THE NECK is the name given to a peculiar form of cystic growth which is generally found to lie in the line of the sterno-mastoid on one or sometimes on both sides, and which is, in the majority of cases, of congenital origin, and therefore noticed at or soon after birth; but, in rare instances, develops much later and even at an advanced age, one having been described in a patient over seventy. The congenital form is identical with the condition which goes by the name of 'cystic hygroma,' and which occurs also in the axilla, on the back, and around the kidney; but when developing in later life, the disease bears a resemblance to the single blood-cysts which are found in other parts of the body.

The growth is composed of cysts which push forward the healthy skin covering them, and render it tense, so that their conformation, lobulated form, and even their contents, may be seen through it. They may present at any part of the neck between the mastoid process and the clavicle, but the favourite situation is below the jaw, or springing from the posterior triangle of the neck. In size they show great variety, sometimes being quite small, at others attaining enormous proportions. Their progress is remarkably capricious, at one time remaining at a standstill, and at others increasing with great rapidity, and this even after many years of quiescence. The whole, or a portion, will sometimes diminish in size, or altogether disappear. Nor are all the parts found to increase in the same ratio, and thus they will occasionally cause symptoms of pressure without any evident increase in bulk. It is to their pressure-effects that their fatality in early life is to be ascribed, since they are often continued down into the thorax, surrounding the trachea, and extending into the mediastina.

Cause and Pathology.—On dissection, the tumour appears to be an aggregation of cysts, often in great numbers, the components of which are nothing but an exaggeration or hypertrophy of the cellular tissue of the part. Although presenting superficially, they generally originate beneath the deep cervical fascia, and protrude in all the parts with which that structure is connected. Thus, they sometimes are situated beneath the tongue, and cause one of the forms of ranula, or they may pass across the median line and present upon both sides of the neck, and, as already stated, may extend into the thorax or axilla. The fluid contents are enclosed in a wall of areolar tissue, smooth, glistening, and finely fibrous, though differing greatly as to consistence, even in various parts of the same tumour, so that the larger cysts will be found enclosed by a thin covering, and the smaller by a dense wall of similar structure. The size of the cysts varies from that of a pea to that of an orange, and their contents are equally prone to vary as to colour and consistence. The fluid in one will be found to be clear and watery, while that of its adjoining neighbour may be composed of blood-stained serum, in which may float white, flocculent particles of lymph-coagulum; and whilst one cyst may give the sensation of a bag of fluid, the adjoining ones may be so tense as to appear solid. Occasionally fleshy masses are seen in the growth, but, as a rule, the only solid elements consist of hypertrophied connective tissue. Lymphatic glands are not affected, but are often surrounded and enclosed, as are also the vessels and nerves. The size to which, in some cases, these tumours have attained is enormous, and they are prone to inflame under very slight provocations, as from blows, &c., or will often do so spontaneously.

The *symptoms* and *diagnosis* of this affection are so obvious, that little need be said as to any distinction which must be drawn between it and other tumours which may occur in this region. Large venous nævi are the only swellings with which it is likely to be confounded; but in these the dilated walls of the numerous veins show through the thin coverings of the skin, and, as opposed to what occurs in a cystic growth, their bulk can be diminished by firm pressure, and their size is immediately re-established when it is relaxed. To fatty tumours these growths may bear some resemblance; but whilst the one is seldom, the other is nearly always congenital, and can, when rendered tense, be made in some part translucent with a strong light.

Treatment.—When it seems fairly probable that the tumour is only a single cyst, it is justifiable to try the effect of tapping, with or without the subsequent injection of tincture of iodine, or Morton's solution, composed of iodine, iodide of potassium, and glycerine. After injection, the trocar should remain for a few seconds, to allow any remaining fluid to drain off. But when, as is most usually the case, there are numerous cysts, by far the most successful method of treatment is to pass a seton of fine silk or catgut through a portion of the tumour, and to leave it until some sign of inflammation is evident, but before suppuration has taken place, when it should be withdrawn.

Inflammation of this hypertrophied tissue is very easily excited, and it must be allowed to subside before the introduction of a fresh seton into any other portion of the growth. Should suppuration occur from any cause, an incision must be made and a drainage-tube inserted, the cavity being freely washed out with some antiseptic solution. It will usually be found that when a portion of the tumour has begun to contract, the rest will follow suit, and therefore due time must be given for this to occur. If a large portion appear to be solid, and yet the increase in size of the whole tumour be evident, the question of excision may be entertained; but this is seldom to be advised, on account of the deep connections of these cysts, and the tendency to resume growth shown by any portion which may be left. John H. Morgan.

HYDRONEPHROSIS, or the distension of the pelvis of the kidney with urine, is a comparatively common affection, especially when unilateral; double hydronephrosis is, on the other hand, rare.

The *causes* of this condition are many. The commonest is impaction of a stone in the top of the ureter; next to this the closure of the latter by some inflammatory change; then tubercular deposits blocking the ureter, or the contraction of a tubercular ulcer. Again, growths of the kidney of various kinds may cause retention and hydronephrosis, the commonest being papillomata. Besides these, pressure from without may initiate retention of urine in the pelvis of the kidney, and a consequent obliquity of the course of the ureter in the wall of the distending sac may perpetuate the condition. Among the sources of external pressure on the ureter may be mentioned the gravid uterus, perimetritis, tumours of the pelvis, and, finally, the presence of an aberrant renal artery. Finally, there is in some kidneys an almost valvular arrangement of the mucous membrane at the point of origin of the ureter, which predisposes to the formation of this condition and maintains it when once produced. In no recorded case, so far as the writer can ascertain, has hydronephrosis been proved to have resulted from injury to the ureter itself from without, with cicatricial closure of its lumen. In a few cases, however, the history and symptoms at first appeared to point to such a cause (vide *Lancet*, January 17, 1885); but in all the accumulation was shown, later on, to be retroperitoneal effusion of urine from a torn ureter, and not from distension of the pelvis of the kidney. This form of lumbar 'urinary abscess' might perhaps be called 'spurious hydronephrosis,' resembling as it does so closely the true form, and under this head it will be considered lower down.

The *objective symptoms* of hydronephrosis are usually the same, however the condition be produced. We find a large fluid tumour in either flank, having in all cases the same relations. It lies below the liver, and behind and outside the colon. It begins to grow above, and enlarges downwards and inwards towards the umbilicus, and may even cross the middle line of the body. With such a tumour there is dulness over the flank behind, between the ribs and iliac crest, and extending forwards until the colon note is reached at a varying point. This dulness reaches vertically from the liver to the iliac fossa as a rule, and over the same area a distinct wave can usually be felt on percussion with the fingers. In doubtful cases, the exact relation of the colon to the swelling can be ascertained by alternately filling and emptying the bowel, with fluid or air pumped in through the anus. The size of the tumour varies greatly, but as its presence is not usually accompanied by much suffering in the earlier stages, it is first met with by the surgeon, as a rule, when it has become very large, and contains many pints, or even gallons, of fluid.

The *subjective symptoms* are few, and only noticed definitely when the tumour has reached a large size. Slight pain, of a dull, aching character, may be complained of, but is usually absent. Digestive derangements, due to pressure of the growth upon the intestines and consequent constipation, may also be observed. The tumour may also produce a certain amount of dyspnœa by interfering with the descent of the diaphragm. There is one symptom which, if present, is characteristic of hydronephrosis. This is the sudden passage of very large quantities of urine, with subsidence of the lumbar swelling, and the rapid reappearance of the latter after the flux has ceased. This indicates the sudden removal of the obstruction for a time, and the escape of the contents of the hydronephrosis into the bladder. Exploratory puncture, with a fine aspirator-needle, will also generally settle the nature of the tumour. This should always be done from behind, midway between the iliac crest and last rib, and about two and a half inches from the spinous processes, at which point no structure of importance can, with ordinary care, be wounded. If a clear fluid is here drawn off from a tumour, having the relations detailed above, it is almost certain to be a hydronephrosis.

The *diagnosis*, thus made, is not weakened by the discovery that the fluid drawn off contains only a trace of urea and is rich in albumen, for it is now well known that urine secreted against a steady resistance, such as the elasticity of the sac receiving it in this case, is always deficient in urea in proportion to the resistance to be overcome; it is also noticed to contain, as a rule, much albumen and mucin. This is true even of a perfectly healthy kidney, whose ureter has only recently become blocked. The amount of urine secreted by a kidney, under such circumstances, is also diminished, but not to a very large extent. That all this is the result of the obstruction alone, is proved by the fact that if a recent hydronephrosis, whose fluid only contains 0·1 per cent. of urea, be drained through the loin by a carefully-fitting tube, the urine may rapidly regain its normal percentage of urea, &c., the resistance being removed. But where a hydronephrosis has lasted for a long time, it has been shown that the kidney becomes, at last, permanently damaged and incapable of secreting urea or even furnishing urine, except in traces. In such a case, not only is the pelvis enormously distended, but the kidney proper is found stretched into a thin, fibrous plate, as it were, which lies like a cap upon the upper and back part of the sac, covering, perhaps, an area of six or eight inches, and showing little or nothing of its original structure.

Prognosis.—If a hydronephrosis be left untreated, one of three results may be looked for. (1) It may go on enlarging until the patient is gradually exhausted by the distress due to its pressure upon other abdominal organs. (2) It may rupture, with or without external injury, the fluid escaping into the peritoneal cavity and causing peritonitis, or, in very rare cases, becoming absorbed without further mischief. (3) It may grow to a large size, and then, owing to the complete atrophy of the kidney as the result of pressure, it may, at last, become slowly absorbed again.

The best *treatment* for hydronephrosis is a problem yet to be solved. In a few cases, where the condition is due to blocking of the ureter by calculus, the latter may, perhaps, be helped to pass into the bladder by manipulation over the track of the ureter, aided by hot baths and the use of sedatives and antispasmodics. But this could only be possible in comparatively recent cases of obstruction. The same may be said of the operation of cutting down upon the ureter and opening it for the extraction of the stone. This procedure will, probably, be put in practice in the future, when we have collected sufficient facts for a positive diagnosis, but, although proposed many years ago, it has, so far, not yielded any fruit. Even if a urinary fistula remained after such an operation, still the gain to the patient would be great, for a time at all events, and would not very unfavourably influence any subsequent procedure chosen for the final relief. In the more chronic cases, where the seat of the obstruction cannot be defined, the surgeon now-a-days will not be inclined to await the possible atrophy of the kidney and absorption of the fluid, knowing the remoteness of the prospect and the risks constantly incurred.

There remain, then, only three measures for relief: (*a*) repeated aspiration, (*b*) free drainage, (*c*) excision of the sac and kidney together. There are, perhaps, a very few cases in which repeated aspiration at the point of election (*vide supra*) may be followed by permanent cure. They are those in which the secreting powers of the kidney are almost, or completely, destroyed, and we have simply to deal with a cyst whose walls are practically inert. But such cysts would require very frequently repeated aspirations before they could be brought to contract finally, if they ever did so. Free drainage of hydronephrosis is not much more successful than aspiration, and is not devoid of risks. Of course a large sac will be in a better position to contract if freely and continuously drained, than if only occasionally emptied. But the time consumed in the process is usually very great, and the patient often suffers great distress from the process of drainage, and the necessity, lasting for months, for constantly changing the wet dressings. Again, there is always the risk of suppuration in the sac, with consequent septic infection. This may usually be guarded against by careful antiseptic treatment of the opening, which should always be made at the point of election behind. If kept aseptic the drainage may prove useful in relieving the patient's immediate distress, and preparing the way, in suitable cases, for the more radical treatment of nephrectomy (q.v.) But if allowed to suppurate the sac will contract firm adhesions to the parts around, and the difficulties of the latter operation will be greatly increased if it be undertaken. It must, therefore, be carefully considered, in every case, whether it would not be better to proceed to the removal of the kidney at once, without complicating the case further, at all events after a sufficiently free but short drainage. There are cases where, undoubtedly, immediate nephrectomy is the best treatment. The patient's age and general state of health, taken together with the duration of the disease, are the only guides, but upon these points no definite rules can be laid down.

A. E. Barker.

HYDROPHOBIA.—A disease in man resulting from inoculation with the virus of a rabid animal, and characterised, among other symptoms, by spasmodic contractions of the pharyngeal muscles, and consequently by inability, in the majority of cases, to swallow fluids.

The morbific substance is contained in the saliva or oral mucus of the rabid animal, and is harmless when applied to an unbroken cutaneous or mucous surface. If introduced into the subcutaneous tissues it produces in animals rabies, and in man hydrophobia, provided that the individual so inoculated possess the requisite susceptibility for the disease. This would appear to be a necessary condition, from the fact that of persons bitten by rabid animals a large majority, variously estimated at from 60 to 95 per cent., escape without further consequences. This might be explained by the assumption that those who so escape were not inoculated, and that the poison had been intercepted by the clothing, or that, by precautionary treatment, the poison had been neutralised. In support of this is the fact that bites on the face, hands, or other exposed parts more frequently result in hydrophobia than when parts protected by clothing have been bitten. But the experiments of Hertwig seem to prove that in dogs such susceptibility is essential, as only 37 per cent. of the animals experimented upon became rabid. One dog, a pug, was fruitlessly injected nine times in three years with matter which induced rabies in other dogs. The recent experiments of Pasteur also appear to demonstrate the insusceptibility of some dogs to inoculation; for, although he was more successful than Hertwig in inducing rabies, three dogs, out of an unspecified number experimented on, proved to be insusceptible to repeated inoculations.

The symptoms of rabies in the dog and of hydrophobia in man are very different; but the fact that inoculation of dogs with the saliva of hydrophobic patients has induced rabies, establishes the identity of the diseases.

Inoculation is generally the result of the bite of a rabid animal, and dogs are the most frequent agents; but the bite of rabid wolves, foxes, jackals, hyænas, cats, pigs, and even herbivorous animals, has induced the disease. It does not appear to be proved that the animal must necessarily be rabid, so that precautionary treatment should be employed in all such wounds, whatever may be the condition of the animal. Some cases are recorded where the disease resulted from the scratch of a cat, whose claws were probably smeared with saliva. One case was caused by an accidental wound in the dissection of a dog which had died of rabies. Another case is said to have resulted from the patient having used his teeth to loosen the knots in a rope with which a mad dog had been tied. Such cases suggest the necessity of caution on the part of attendants upon hydrophobic patients.

Hydrophobia, compared with other acute specific diseases, is characterised by the long duration and variability of the latent stage. From recorded cases it would seem to vary from fourteen days to nearly as many years. But in the great majority of cases active symptoms manifest themselves within three months from the date of the wound, and in only six per cent. of 147 well-ascertained cases has the latent period lasted for more than six months. Very prolonged periods can therefore be only accepted with some reserve. The latent stage, or delitescence, is not marked by any characteristic symptoms. Some writers have observed unusual appearances in the wound or cicatrix, but these probably resulted from the treatment adopted; others have noted symptoms of mental disturbance for the first few days after the wound, naturally enough if the patients were aware of the risk that they had incurred. Marochetti's vesicles, or the so-called 'lyssi,' for some time attracted attention. They are vesicular or occasionally solid projections on the mucous membrane of the tongue, lips, or cheeks, which are said to form from the third to the twentieth day after the wound, and at one time the safety of the patient was believed to depend on their thorough extirpation. They are, however, not always found, and their significance has not been established.

In the active stage, or recrudescence, the first symptom which usually attracts attention is difficulty of deglutition. The patient when about to drink is checked by a sudden inspiratory spasm. In some cases this is preceded by sleeplessness and general malaise.

The patient now usually complains of a feeling of fulness and stiffness in the throat, of compression of the chest and difficulty of respiration, and of numbness, tingling, or neuralgic pains at the seat of the wound or its immediate vicinity. In one case, a boy aged fourteen, who had been bitten on the back of the right hand five months before the onset of acute symptoms, complained of such severe pain along the right ulnar nerve, which was relieved by pressure, that the writer was reluctantly induced to divide the nerve behind the internal condyle, without any benefit to the patient. Great restlessness and suspicious watchfulness are very marked at this stage. All the symptoms indicate disturbance of the central nervous system, especially of the lower part of the medulla oblongata, where the centres for respiration and deglutition are situated. As the disease progresses, hyperæsthesia is conspicuous. Convulsive spasms become frequent, and are excited not merely, as at first, by attempts to swallow fluids, but by any peripheral stimulation. A current of cold air, a flash of light, a bright colour, some glittering substance, a sudden noise, as the shutting of a door, trickling of water, or the mention or even thought of fluid, may excite them. These spasms especially affect the muscles, both ordinary and extraordinary, of inspiration, and are sometimes so prolonged as to threaten suffocation. Sometimes all the muscles of the trunk are convulsed, and there is marked opisthotonos. In the intervals the respiratory movements are shallow and hurried. The pulse is usually small and frequent. The salivary glands generally secrete abundantly, and the patient, being unable to swallow, expectorates in all directions. If the secretion be viscid the patient has much difficulty in getting rid of it. The tone of the voice is often altered from want of co-ordination of the muscles of vocalisation. Hence probably originated the old stories of hydrophobic patients foaming at the mouth and barking like dogs.

As the higher cerebral centres become involved the patient may have hallucinations, or even violent delirium. But these symptoms are not persistent, and the patient is usually intelligent and fully conscious of his miserable condition. His sufferings are aggravated by great thirst. Sometimes there is vomiting of bilious fluid. At the commencement of the acute stage there is not infrequently, in adults, increased sexual desire, and there is often priapism even in children. The urine is scanty, and generally contains albumen.

In the intervals between the convulsions the patient sometimes sleeps, especially if narcotics have been employed; but usually the sleep is restless and of short duration.

The acute stage generally lasts from one to two days—very rarely longer. It is succeeded, if death has not occurred, by a period corresponding to the paralytic stage of rabies in the dog. The convulsions either cease altogether or greatly abate in force and frequency. The power of deglutition is regained, but the patient is weak and feeble; the respirations and pulse are frequent; the skin is bathed in clammy perspiration; and death, apparently from exhaustion, speedily supervenes.

The above description is not applicable to all cases. Indeed, no two cases are exactly alike. In some mental disturbance, in others convulsive seizures predominate. Occasionally even the test symptom of difficulty of deglutition is altogether absent or exists in a very slight degree. Some writers explain these variations by assuming that there are varieties of the disease, but they are probably due to idiosyncrasy of the patient and varying powers of resistance in the nerve-centres.

Pathological Anatomy.—The early onset of rigor mortis and decomposition, the fluidity of the blood, and congestion of the fauces, lungs, and kidneys, have long been noticed in this disease. These, with minute ecchymoses beneath the pleura, pericardium, and membranes of the brain and spinal cord, are usually the chief macroscopic phenomena. Microscopically, degeneration of the ganglion cells in the nuclei of the tenth, eleventh, and twelfth cranial nerves, and, to a less extent, of the ganglion cells in the cortex of the cerebral hemispheres, with exudation into the peri-vascular spaces of the brain and spinal cord, especially in the medulla oblongata, thromboses of small vessels and miliary abscesses, have been discovered. Klebs, quoted by Reder in the *Deutsche Chirurgie*, 1879, found in the lymphatic and submaxillary glands granular, very refractive corpuscles of a pale brown colour, aggregated in longitudinal bands or in stellate groups, usually in the course of the blood-vessels, which may, as he suggests, be the vehicles in the transmission of the disease.

Treatment.—All wounds caused by bites should be thoroughly cleansed as soon as possible. Bleeding should be encouraged, and the wounds then be cauterised. In quite recent cases the solid nitrate of silver will suffice; but, if some interval has elapsed, nitric acid or the actual cautery should be employed. Some recommend excision of the bitten part; but this seems needlessly severe as a merely precautionary measure. Some simple dressing should then be applied, and the patient's mind should be diverted from the subject. When acute symptoms have appeared, all sources of excitement should be prevented. The patient should be kept in a darkened room, with as little physical restraint as possible. If attempts to swallow induce convulsions, nutrient enemata should be administered. No specific has been discovered for this disease. Mercurial inunction combined with hot-air baths has been apparently successful in a few cases. Hypodermic injections of curare, in doses of from $\frac{1}{16}$ to $\frac{1}{4}$ of a grain, may be tried; but the effect must be carefully watched, lest paralysis of the respiratory muscles supervene. Aconite, preparations of arsenic, atropine, calabar bean, cold affusion and ice to the spine, have been employed, but mostly without any advantage. Narcotics alleviate the symptoms, and of these morphia, administered hypodermically, and chloral hydrate by the rectum, appear to be the most efficacious. Anæsthetics prevent the convulsions while the patient is under their influence, but in some cases they cannot be tolerated. In the boy before alluded to, whose ulnar nerve was divided, the attempt to administer chloroform induced a dangerously long-continued inspiratory spasm. This has been observed in other cases also. Tracheotomy has been suggested, and, if the spasm were limited to the laryngeal muscles, would be most serviceable; but as all the muscles of inspiration are generally affected, the utility of the operation is not apparent. Quietude, narcotics, and nutrient enemata would appear to be the most suitable treatment.

The *prognosis* is very unfavourable, although a few cases of apparently genuine hydrophobia have recovered. Pasteur's experiments, which have not yet been completed, appear to indicate that dogs can be rendered insusceptible of rabies by being inoculated with the suitably attenuated virus of rabid animals. If this be substantiated we may look forward to the disappearance of hydrophobia, and prevention will indeed be better than the hitherto futile attempts to cure.

Diagnosis.—Hydrophobia so greatly resembles tetanus in some respects, that it has been proposed to classify it as a variety of that disease by the name of tetanus rabicus. From ordinary tetanus it may be distinguished by the duration of the period of incubation, by the absence of trismus, by the characteristic inspiratory spasm, and by the remissions during the acute stage. From the literature of hydrophobia it is evident that cases of acute mania and of hysteria have been mistaken for it, from the inability—real or pretended—of the patient to swallow fluid. But the absence of all the other symptoms of hydrophobia, and notably of the acceleration of the pulse, should suffice to prevent such mistakes.

Jeremiah McCarthy.

HYDROPS ANTRI. *See* Antrum, Diseases of the.

HYGROMA. *See* Hydrocele of the Neck.

HYMEN, Imperforate. *See* Vagina, Affections of the.

HYOID BONE, Fracture of the.—Embedded in the soft parts, and placed at the retiring angle between the prominence of the chin and the front surface of the neck, the hyoid bone is rarely fractured.

The cause is almost invariably direct violence, such as a blow, an attempt to throttle, or a fall upon some projecting object. This lesion is also frequently found in the bodies of those who have been hanged. Instances are on record in which it has followed a muscular effort, e.g. in yawning, or a sudden movement of the neck. The great cornu is the part usually broken, and one or other of the fragments may project through the mucous membrane of the pharynx. Most of the cases on record have been in adults.

Symptoms.—Pain in the part, aggravated by all movements of the tongue and pharynx, such as speaking, masticating, and swallowing. In some cases also the attempt to open the mouth or move the neck is painful. Swelling and ecchymosis will be observed in the upper part of the neck, or about the floor of the mouth. There may be huskiness or loss of voice, with coughing and occasionally severe dyspnœa. There is sometimes a free flow of saliva, which may be mingled with blood if the mucous membrane has been wounded. On manipulation the mobility of the fragments can usually be ascertained, and crepitus can be felt where there is not much displacement. By introducing the finger through the mouth the diagnosis will be assisted, and any projection of the fragments beneath or through the mucous membrane will be readily detected.

Treatment.—If there is displacement, the surgeon must endeavour by manipulation to reduce the fragments. By the help of a finger in the mouth and gentle pressure with the fingers of the other hand externally, this object may usually be effected. The patient should then be kept in bed, and must not be allowed to speak. By means of a bandage placed round the head and attached below to a broad belt round the chest, the movements of the neck should be prevented. Hæmorrhage should be checked by giving the patient ice to suck. In severe dyspnœa and laryngeal irritation it will be necessary to resort at once to laryngotomy; or, if the injury extend to the laryngeal cartilages, or the soft parts covering them, tracheotomy may be preferable. Liquid food and sops should be given, but if the attempt to swallow causes great pain and coughing, or if it displaces the fragments, it may be necessary to feed the patient with nutrient enemata. In some cases, however, this difficulty may be met by the use of an œsophageal tube.

To relieve the local swelling and pain, a lead and opium lotion may be used, and leeches are sometimes beneficial.

As a rule the more acute symptoms subside in a week or two, and the consolidation of the parts allows a certain amount of movement. Bony union takes place in the course of a few weeks. Occasionally necrosis of part of the bone, accompanied by the formation of foul abscesses, may cause great delay in the healing process, and the patient may succumb to the exhaustion or septic condition thus produced.

N. Davies-Colley.

HYPERIDROSIS (Excessive Sweating).—*Cause.*—Hyperidrosis may be (1) symptomatic in some general disease of a febrile character—rheumatism, pneumonia, &c.; or (2) it may depend on the debility induced by exhausting disease (phthisis). (3) It may be due to some affection more essentially neurotic in character, as in cases where it accompanies neuralgia or paralysis. (4) It occurs idiopathically, and may be regarded rather as an anomaly of function.

Pathology.—A functional disturbance of the sweat-glands, increasing the quantity of sweat secreted, but not altering its character.

Symptoms. — The condition may be acute or chronic, general or local. When accompanying febrile conditions it is more often general, and is sometimes attended by the formation on the surface of the skin of minute, evenly-distributed, and closely-set pellucid vesicles (sudamina). They are formed by small collections of sweat beneath the cuticle. Occasionally sudamina become somewhat turbid, in which condition they have received the name 'miliaria alba'; or they may be accompanied by a certain amount of inflammatory halo, and have then received the name 'miliaria rubra.'

It must be noted that excessive sweating is sometimes accompanied by a lowered temperature.

Local hyperidrosis is most frequently met with on the perineum and adjacent parts, axillæ, palms, and soles; but other forms of local hyperidrosis are met with, often unilateral, and as part of a local neurotic disturbance. The form of hyperidrosis which most often calls for treatment is the sweating of the palms or soles; this condition, which may be temporary or permanent, gives rise to great annoyance, interfering with an occupation, or with the patient's social duties and pleasures. The continued maceration may lead to changes in the skin between the fingers or about the perineum or adjacent parts—that is, to an erythematous eczema (intertrigo).

On the soles there are more often seen rounded patches of sodden, whitish epidermis, like that of the washerwoman's hand, the patches eventually desquamating and leaving the part beneath red and tender. Not infrequently the part drifts into a chronic desquamative condition, indistinguishable from eczema of the sole. This sweating of the feet is rarely unaccompanied by fetor, due to the proneness of the sweat to decompose after its deposit on the surface, or to the presence of a bacterium (Thin). Hyperidrosis is naturally worse in summer than in winter.

Treatment.—Quinine, iron, belladonna, or dilute sulphuric acid, may be given in cases where it may be desirable to treat the condition internally. The hypodermic injection of atropia (gr. $\frac{1}{100}$–$\frac{1}{50}$) is said to be of great service. In cases where the sweating is accompanied by debility, a general tonic treatment is obviously indicated.

It is, however, the local and more permanent varieties which call for treatment, and this is more likely to be successful when of a local character. Dusting powders, such as the following:—℞ Acidi salicylici, gr. xx.; zinci oxidi, ʒiij.; kaolin ad ℥j., may be perseveringly applied, after cleansing, night and morning; or the parts may be bathed in astringent waters—e.g. sulphate of zinc, alum, or acetate of lead, a drachm of either to the pint of water.

Tincture of belladonna, either pure or diluted, is well spoken of as a local application, but toxic effects should be watched for. For cases which resist such treatment, the following plan may be adopted:—The feet, after being washed and dried, are to be enveloped in neatly-applied dressings smeared with the following ointment—a modification of Hebra's unguent. diachyli: ℞ Emplast. diachyli, ʒiv.; olei olivæ, f ʒiv. The plaster to be melted, and the oil added, and stirred until a homogeneous mass results; bandages to be applied, and clean stockings and new boots to be worn. In twenty-four hours the feet are to be redressed in the same way after being wiped (not washed), and dusted with dusting powder. The treatment is to be carried out for ten to twenty days, after which the dressings may be discontinued, and the dusting powder only applied. The process may have to be repeated. Desquamation occurs, beneath which the epidermis is tender at first. ALFRED SANGSTER.

HYPERMETROPIA, a congenital or acquired error of refraction of the eye, in which, with the accommodation at rest, the focus of the lens-system of the eye does not lie upon the layer of rods and cones of the retina, but at an imaginary spot behind. The physical state may be a short antero-posterior axis, too low refractive power of the media, insufficient curvature of the refracting surfaces, imperfect growth of the crystalline lens, or absence of the lens. *See* REFRACTION, Errors of.

HYPEROSTOSIS. *See* JAWS, Diseases of the.

HYPERTROPHY, in its surgical sense, is the term used to indicate enlargement of an organ, or overgrowth of a tissue. When analysed pathologically, it will be seen to include the results of very different causes of increased nutrition. Thus, there are the PHYSIOLOGICAL HYPERTROPHIES which happen as phases of the normal life-history of the body. Amongst these may be mentioned the enlargement of the uterus incidental to pregnancy; and the changes that develop in the female breast at the age of puberty, and prior to lactation. It may be said generally that physiological hypertrophies are intended to provide the means for a quantitative increase of functional activity, and that when the functional call ceases the increment of tissue is removed by consecutive atrophy.

Then there are certain cases in which a part passes beyond the level of natural growth, either as a congenital deformity—e.g. an enlarged hand or foot—or as an acquired excess and perversion of nutrition. The latter are apt to arise at certain epochs of life, and this feature is not the least of their characteristics. Diffuse hypertrophy of the breasts in young women, and enlargement of the prostate gland in old men, are familiar examples. Now, inasmuch as there is no sufficiently obvious explanation of such overgrowths, they have been designated *spontaneous*—a very convenient expression, but one which gives no information.

In hypertrophy of the prostate the glandular, muscular, and fibrous elements are all multiplied, and amyloid bodies are formed with tolerable frequency.

COMPENSATORY HYPERTROPHIES are induced for the purpose of overcoming increased resistance to muscular action; or for substituted service where one of duplicate glandular organs is, from some cause or other, crippled in its function. Numerous illustrations of the former group are met with in practice—e.g. stricture of the urethra entails hypertrophy of the bladder and ureters; stricture of the rectum a like condition of the contractile coat of the bowel above the seat of obstruction. The heart undergoes marked enlargement from incompetency of the valves or stenosis of the cardiac orifices. In these cases dilatation supervenes on the hypertrophy when the limit of compensation is reached, or, in other words, when the mechanical impediment interrupts the vascular supply of the muscles involved. In children, the bladder is occasionally hypertrophied without there being any recognisable obstruction to the flow of urine; indeed, it would seem that mere excess of function from long-continued derangement of the nervo-muscular dynamism—commonly known as 'irritable bladder'—is sufficient to account for the overgrowth of the vesical muscles. Elongated prepuce, ascarides, and polypus of the rectum may be the initial cause of the mischief, but, on the other hand, the functional disturbance may be purely intrinsic.

Hypertrophy is more common and more pronounced in the involuntary than in the voluntary muscles—(1) because the former are subject, in their normal state, to perpetually recurring frequent stimulation, and (2) because in them unusual resistance is more liable to arise and more difficult to remove. Up to a certain point the voluntary muscles grow in response to the extra call on their contractility, but beyond this the repair, during the shortened intervals of rest, is not equal to the loss sustained by over-exercise. When the muscular fibres are merely enlarged, the hypertrophy is termed 'simple;' when they are multiplied, it is called 'numerical.'

The disease known as *Pseudo-hypertrophic paralysis* (q.v.) affects the voluntary muscles, especially those of the calves. As regards the muscular fibres, it is essentially an atrophic change, the apparent hypertrophy depending mainly upon fatty infiltration within and without the sarcolemma.

When one kidney is undeveloped or atrophied, the other grows to meet the requirements of the system. The existing urinary tubules—and notably the secreting cells—are increased in size, and probably new ones are formed.

IRRITATIVE HYPERTROPHIES.—The stimulus to increased nutrition is an artificial one, and its incidence often owing to chance. The results, which in the gross are classed with the hypertrophies on account of the bulk acquired, are largely inflammatory overgrowths, modified in each case under the influence of the special formative property of the tissues implicated. Intermittent pressure is a common cause of hypertrophy (continuous pressure leads to atrophy). It acts by teasing the structural elements into greater nutritive activity, and by determining an extra supply of blood to the part.

The pressure of tight and badly-fitting shoes is a fertile source of corns. Misdirected pressure, as when, through varus, the weight of the body is thrown on the outer surface of the foot, causes thickening of the skin and effusion into the subcutaneous tissue. The effusion is often so collected and circumscribed as to constitute a bursa, over which the callosity glides. The papillæ and hairs on the outskirts of chronic ulcers of the leg are always hypertrophied; and so, commonly, is the underlying bone, which is then marked by a flattened node with well-defined margin.

Elephantiasis Arabum, a diffuse overgrowth of the skin and subcutaneous connective tissue, is a good example of irritative hypertrophy. It affects chiefly the scrotum and legs of Orientals.

Probably no other tissue shows such diversity in the degree and manner of hypertrophy as the osseous. In atrophy of the brain the cranium responds with concentric hypertrophy; and when the cranial contents are amplified, eccentric overgrowth of the encasing bone is the usual concomitant. Thickening of the cranial bones, with filling in of the diploe, is one of the features of senility.

Hypertrophic lengthening of a long bone may be due to some constitutional state—e.g. syphilis; more rarely it is complementary to shortening of another bone of the same or the opposite limb. Then there are those curious cases known as 'ostitis deformans,' in which a few, many, or most of the bones in the body are distorted by massive deposits and curvatures. Equally interesting, and puzzling as to its intrinsic nature, is the occasional progressive hypertrophy of the facial bones. 'In such cases the bony deposits are spongy, puffed, nodular, so that the bone acquires a resemblance to skin affected with elephantiasis.'—Billroth. Augustus J. Pepper.

HYPOCHONDRIASIS (in the male), a mental condition, usually hereditary, akin, and often the prelude, to melancholia, characterised by great depression and a tendency to exaggerate or imagine symptoms of some physical ailment or defect.

In surgical practice it is generally met with in association with bleeding piles, so-called fissure of the anus, urethral stricture, apprehended impotence, varicocele, &c. Any local affection attended with pain, loss of blood, or prolonged purulent discharge will, in persons of feeble nervous organisation, react upon the system and increase the hypochondriacal tendency. Appropriate and successful treatment of the local ailment will therefore produce considerable improvement in the mental condition. But if there be no objective local ailment, the prognosis is very unfavourable.

If hypochondriasis be complicated by varicocele, the patient usually attributes his condition to this cause, and complains of aching pains and abnormal sensations in the corresponding testicle or spermatic cord. But varicocele very rarely requires operative treatment, and experience has proved that its removal in these cases does not benefit the patient, who still complains of pains when the supposed cause has ceased to exist.

Apprehension of impending impotence is a frequent symptom. The patient's thoughts are engrossed with the subject. He studies all his symptoms, and is alert to discover additional evidence of his incapacity. Stimulated more by curiosity as to his condition than by appetite, he attempts sexual intercourse, and if anxiety as to the result produce failure, as not infrequently happens, his mental depression is correspondingly increased. Such patients often volunteer confessions of self-abuse or of premature and excessive indulgence in venery. These aberrations are, in part at least, due to defective mental control; but indulgence in them reacts injuriously on the nervous system. Hypochondriasis is frequently met with in hospital practice, and many cases of so-called malingering are due to this cause. The patient wastes his life in going from one hospital to another, without benefit to himself or satisfaction to his surgeon.

The diagnosis of hypochondriasis is not difficult. The patient's exaggerated complaints and unusual sensations, without any objective cause, sufficiently indicate his condition.

Treatment.—Any local source of pain or irritation must be appropriately treated; but the ministering to a mind diseased belongs more to medical than to surgical practice. Jeremiah McCarthy.

HYPODERMIC INJECTION.—By this term is understood the administration of drugs by injecting them in a concentrated form beneath the skin, into the lymph spaces, from which they are readily absorbed into the general circulation. This method possesses the following advantages:—(1) Rapid effect of drug; (2) more powerful effect produced; (3) direct local effect on tissues, especially nerve-trunks; (4) avoidance of direct disturbance of alimentary canal; (5) economy.

A. *Operation for Rapid Absorption.*—Care having been taken that the small hypodermic syringe is perfectly clean, and that the washer of the piston is supple and airtight, a sufficient quantity of the drug is drawn up into the body of the syringe, and all air excluded by turning the needle upwards and pressing the piston. The skin on the back of the forearm or elsewhere having been pinched up for about two inches and stretched tightly, the needle is driven, with a single rapid thrust, deeply into the subcutaneous tissue, into which the fluid is then slowly injected; the needle is then as rapidly withdrawn, and the thumb placed on the puncture to prevent a possible slight oozing of the fluid injected.

Points to be noted in connection with the foregoing are—

(1) Syringe: the barrel should be of glass, upon which are directly screwed the fittings at each end. Minim or cubic millimetre divisions should be marked on the barrel, and not on the piston-rod, on which, however, should be placed an adjustable stop. The piston should have a double cup-shaped washer, the halves being separated by a groove. If the washer becomes dry it is always best to soak it in warm water. Before and after use, the syringe and needle attached should be washed thoroughly in pure water, the needle dried, and a wire inserted in it.

(2) Fluid, to be injected, must be in as small a quantity as possible without being so concentrated as to cause irritation on that account. (The irritative effect of many drugs can be avoided by judicious combination with atropia, &c.) If the quantity to be injected exceeds 15 minims or 3 cubic

Drug	Dose	Employment	Remarks
Acetic Acid	5 minims of 10 per cent. solution.	Check to new growths	Should be injected into growing margin. (Broadbent.)
Carbolic Acid	5–10 minims of 8 per cent. solution	To check infective inflammation and new growths.	In malignant pustule has been injected, 5–20 per cent., under pustule.
Lactic Acid	5 minims of 10 per cent. solution.	Check to new growths	Should be injected into growing margin. (Hüter.)
Osmic Acid	5 minims of 1 per cent. solution.	” ”	Causes pain and inflammation.
Sclerotic Acid	3–5 m.	Excitor of involuntary muscular action in gut and uterus. Hæmostatic.	Far better than ergot. Inject into buttock deeply.
Bromine	1 m.	Check to hospital gangrene	Of doubtful value.
Iodine	1 gr.	Check to new growths (goître, &c.).	
”	$\frac{1}{8}$–$\frac{1}{4}$ gr. (10 m. Tinct. Iodi, or more.).	Strumous glands, tonsils, &c. Radical cure of hydrocele, &c.	
Iodide of Potassium.	3–5 gr.	Check to new growths. Chronic inflammatory disturbance.	Less powerful than iodine.
Arsenic	4 m. of Liq. Arsenic, + equal quantity of water.	Check to new growths, &c.	Painful.
Ferric Perchloride	3–5 m.	Radical cure of nævus, &c.	
Liq. Ferri Perchlor.	10 m.	Check to new growths	
Mercuric Perchloride.	$\frac{1}{16}$ gr.	Cure of syphilis	Should be combined with atropia and morphia.
Ammoniæ Liquor	10 m. in f℥j. of water.	Cardiac stimulant in shock, &c. Antidote to alcohol, opium, and snake poison.	Must be injected into a vein. Danger of local inflammation.
Sulphuric Ether	5–10 m.	Cure of epileptiform neuralgia, sciatica, &c.	Deep injection down to nerve-trunk.
” ”	20–30 m.	Cardiac stimulant in shock or syncope from anæsthetics, &c.	Should be injected beneath skin of breast.
Chloroform	5 m.	Local anæsthetic	Painful at first.
Aconitia	$\frac{1}{200}$–$\frac{1}{64}$ gr.	Check to neuralgia	Best to begin with small dose.
Apomorphia	$\frac{1}{25}$–$\frac{1}{6}$ gr.	As an emetic	Invaluable as emetic. Acts in 2 minutes.
Atropia	$\frac{1}{100}$–$\frac{1}{10}$ gr.	Antidote to opium, chloroform, pilocarpin, muscarin, aconite, &c. Checks excessive secretion.	Valuable to combine with other injections to reduce inflammatory mischief.
Cocaine	$\frac{1}{8}$–1 gr.	Local anæsthetic. Checks congestion of mucous membrane of nose, &c., &c.	Usually in 4, 10, or 20 per cent. solution. Inject 2–4 m. of last.
Curare	$\frac{1}{3}$–$\frac{1}{2}$ gr., or 4 gr. in 24 hours.	To cure tetanus and hydrophobia.	Of doubtful value. Only danger is paralysis of respiratory muscles.
Ergotin	$\frac{1}{3}$ gr., in water	Hæmostatic, &c.	Best to use sclerotic acid, q.v. If neither can be had, use 10 m. of Liquor ergot. ammon. and $\frac{1}{4}$ gr. morphia and $\frac{1}{50}$ gr. atropia.
Eserine	$\frac{1}{120}$–$\frac{1}{50}$ gr.	To cure tetanus	
Hyoscyamin	$\frac{1}{100}$–$\frac{1}{20}$ gr.	Checks delirium of mania and delirium tremens.	
Morphia	$\frac{1}{4}$–$\frac{1}{2}$ gr.	Anodyne. Hæmostatic. Writer has found, with Prof. Schafer, that it diminishes parenchymatous oozing when given just before operation.	Combine with $\frac{1}{60}$ gr. atropine.
Pilocarpin	$\frac{1}{10}$–$\frac{1}{2}$ gr.	To produce sweating in cases of uræmia, &c.	Very useful combined with hot-air bath.

centimetres, it had better be divided, and each part injected in a different place.

(3) The point at which injection is to be made should usually be in the limbs, on the extensor surfaces, where the skin is loose. Least pain and tension will follow where the skin is loosest.

Deep injection is recommended by some, and then the needle is thrust, to the head, vertically into the muscles of the buttock or back.

(4) *Accidents.*—(*a*) Inflammation may be caused by want of cleanliness in the needle, &c., decomposition of the fluid to be injected (growth of fungi, &c.), excessive quantity of fluid injected, inflammation being set up by simple tension. (*b*) Injection into a vein, and consequent toxic symptoms from too rapid absorption of drug. These can all be avoided by ordinary attention.

B. *Operation for Interstitial Injection to check New Growths.*—Tumour to be cleansed, pedicle to be constricted, if possible, during and for a short time after injection. The needle is to be thrust deeply into the substance of the growth, the skin having previously been drawn aside to ensure a valvular guard to the puncture in the growth. Points to be noted are—

(1) Avoidance of vessels; accurate filling of syringe; thrusting the needle in first, and waiting to see (by flow of blood through it or not) whether it may chance to have penetrated a large blood-vessel; injection to be slow; quantity of fluid to be small at first sitting, viz. up to fʒj., or less if in such a position as the tonsil, &c.

(2) Accidents are—(*a*) Inflammatory disturbance, to be treated in the ordinary way; (*b*) injection into a vein, which may be fatal; this event to be avoided by observing the flow of blood from the needle, as just detailed.

C. *Operation for Checking Spread of Acute Specific Diseases.*—(*a*) To check spreading inflammation, such as erysipelas, hospital gangrene, traumatic gangrene, &c., inject beneath skin (in cases of gangrene, deep injection must be made as well) ½ inch or about 1·5 cm. in front of the red margin of inflammation, at points about ⅓ inch or 1 centimètre apart, 5–10 minims or about 2 cm. of fluid. (*See* table.) Has also been used (with very concentrated fluids) in malignant pustule.

Special modes of injection are referred to under the various drugs employed.

The drugs given are all soluble either directly in water or glycerine and water, or in water when they are in the form of salts —e.g. sulphates, &c. Victor Horsley.

HYPOPIUM. Pus in the anterior chamber of the eye. *See* Hypopyon.

HYPOPYON denotes a collection of pus in the anterior chamber of the eyeball. It is distinguished from Onyx, which is an infiltration of pus into the lower part of the cornea, by being movable and shifting its position with the movements of the head, so as to gravitate to the most dependent part of the chamber. Its Latin form is hypopium. *See* Cornea, Inflammation of the; Iris, Diseases of the.

J. Tweedy.

HYPOSPADIAS.—This deformity of the male generative organs is one common enough to attract the attention of most surgeons in practice, and is sometimes distressing enough to justify and even to call for persevering attempts to relieve it. It has been the fortune of the writer to see a great number of these cases during the last twenty years. The larger proportion of them have been comparatively slight cases, characterised only by an absence or a bifurcation of the frænum preputii. Usually, absence of a true meatus urinarius, and a backward position of the urethral opening, varying from a quarter to half an inch, were associated with this condition of the prepuce. In all cases, a deficiency of the prepuce at the under part of the glans penis is evident. In most, the prepuce is, on the other hand, redundant upon the dorsum of the penis. This redundancy, in many forms of the malformation, assumes a shape somewhat similar to a hood or cowl, concealing the glans penis as seen from above and in front. At the sides of the corona glandis it slopes off, and is lost on the skin of the penis at the side of the urethra, so that the frænum preputii is split like a hare-lip.

In most of the severer cases, the body of the penis, near the glans, presents a decided downward curve, always more evident during the state of erection. In some cases, the curve thus increased during erection becomes an obstacle to coition, even without any extremely backward position of the meatus. In such cases, the penis as an organ of micturition is efficient, but as an instrument of coition is not so. The curve depends, in all the instances the writer has met with, upon the presence of a rigid band of fibrous tissue, forming the under surface of the corpora cavernosa. This band (which is apparently the result of an attempt to repair or supplement the deficient development of the corpus spongiosum of the urethra) being devoid of erectile tissue, does not accommodate itself to the changing bulk of the corpora cavernosa during erection, and, by its passive resistance, causes the downward curve of the penis peculiar to these cases.

In all the cases met with by the writer, the urethra has been more or less deficient in the proper development of its enclosing sheath of erectile tissue, the prolongation forward of the corpus spongiosum. Its walls are usually formed of mucous membrane, invested by a thin layer of fibrous tissue, which lies under a delicate and fine skin, and is a prolongation of the fibrous investment of the erectile tissue forming the bulb of the corpus spongiosum penis. The fossa navicularis is usually imperfect or entirely absent. The meatus urinarius is a transverse slit, forming a valvular aperture more or less contracted, and sometimes admitting only a fine probe. It may be the cause of a difficulty in micturition and trouble soon after birth. The opening varies in its position, being from a quarter of an inch or so posterior to its normal site, or extending to the base of the penis at the junction of the scrotum with the skin covering the penis, or even into the perineum beyond the scrotum. Frequently there is seen at the base of the penis a sort of navicular depression, indicating the abrupt termination of the bulb of the penis, even when the urethral aperture is placed considerably anterior to it. Between this depression and the actual opening the urethra in these cases is covered by a thin membranous skin, in addition to its mucous and fibrous investment. The skin on the under surface of the penis is generally thin and imperfectly developed, and often looks like an old cicatrix. In one remarkable case of the writer's, occurring in a young and vigorous man of the age of eighteen, this depression at the root of the penis was very marked, the urethra being, however, completed nearly as far as its normal termination by a thinner and finer skin. Although the urethra in this case was completed, and tolerably efficient as a micturating channel, the fibrous bands on each side of the urethra previously described were so thick and rigid that, when erect, the penis behind the corona glandis was bent almost double by their resisting action, so as to render coition quite impossible.

In a certain proportion of cases this deformity assumes a still more remarkable character. The cleft is continued backwards through the scrotum and into the perineum, separating the two halves of the scrotum into two labia, similar to the labia majora of the female. Each of the labia, however, is rather fuller, broader, and more pronounced than in most female children, and usually contains a testicle in a more or less perfect state of development. The urethral groove is continued backward through the anterior half of the perineum, completely severing the two halves of the corpus spongiosum, and ending at the membranous portion of the urethra in a distinct fourchette, resembling that of the vagina in the female. Often, in these cases, there is a prominent valve-like formation of a crescentic shape, somewhat similar to the virgin hymen, and still further increasing the resemblance to the female. When this condition is accompanied by an imperfect evolution and non-descent of the testicle, the resemblance is so close as to afford a real excuse for the common mistake as to the sex of the individual.

Some of these individuals, in whom the testes, although present in the upper part of the labia, are small and ill-developed, have been mistaken for females in whom the ovaries have been drawn down into the labia. Many such cases are recorded. The author, however, considers that all, or nearly all, these persons have been really males. He has never seen one in whom the evidence has been unmistakably in favour of a really feminine condition. They are never, so far as he has seen, provided with a vaginal canal, distinct and separate from the urethral one, and the uterus is altogether absent, the prostate often doing duty as a witness in evidence of that organ. The diagnostic signs most to be depended on are the absence of both vagina and uterus, on examination by the finger *per anum*, with a sound passed through the urethra into the bladder; and the passage of the urine through the opening which has the external appearance of a vagina.

The family history of cases of *hypospadias* usually shows, like that of hare-lip, cleft palate, ectopia vesicæ and epispadias, and other deformities resulting from deficient evolution or arrest of development, a distinctly hereditary tendency. In many families of boys, some degree of the deformity may be observed in more than one, and although the difficulties of ascertaining the atavic peculiarity in such cases are great, from the peculiar position and obscure indications of the slighter cases of the deformity, enough can often be gathered to show that there is a family proclivity. In extreme cases only is it the cause of impotence, and thus the race is continued so long as the less serious results only are present in the individual bearer of the peculiarity. Some curious and valuable evidences of this are given by Mr. A. Lingard in the *Lancet* of April 19, 1884.

Treatment.—The slighter cases of hypospadias, in which the deformity is confined to the prepuce, frænum, and fossa navicularis, the penis serving more or less perfectly to carry the urine away from the clothes in micturition, may with great propriety be left alone. No attempt should be made to improve the slight deformity, which is by no means conspicuous. In more severe cases, where the urethra is open to the extent of its anterior half, the writer has succeeded in carrying forward the urethral tube to the end of the penis by transplanting the redundant dorsal portion of the hood-like prepuce, making a transverse incision or button-hole close to the coronal groove on the dorsum, and passing the glans penis through the aperture. The under surface of the penis was denuded of skin by turning over the urethral groove two lateral flaps, reversed, with the skin surface turned to the urethra, and reaching as far back as the groove extends along the urethra. These were stitched together by a continuous or glover's suture of fine carbolised catgut. The transplanted dorsal hood was then split up into two layers at the cut edge, which was opened and spread out over the raw surface of the reversed urethral flaps, and stitched to the edges by closely applied sutures of fine silver wire. At first, the transplanted prepuce looked rather lumpy, but this was soon diminished by the subsequent contraction, and served well the purpose of conducting the urine so as to make a definite and compact stream, clearing the clothes of the patient.

When the deformity extends as far back as the scrotum, it is usually necessary to take a flap from the front part of the scrotal integument, to eke out the deficiency of the prepuce, and to cover, when transplanted, the whole of the penile urethra. These cases usually give more trouble to cover the urethral groove, an imperfect union of the reflected and transposed flaps often resulting. They are still further complicated by the chordee or downward curvature of the penis during erection, resulting from the more complete arrest of development of the corpus spongiosum urethræ. They usually require operations for the cure of the chordee *previously* to the attempt to cover the urethra.

The writer has, in some cases, succeeded in diminishing to a great extent the degree of the downward curvature of the penis when erect, by making numerous transverse subcutaneous sections of the hardened and thickened tissues on each side of the urethral groove, and keeping the penis strapped upon a couple of thin metal splints covered with red rubber. The splints used were curved slightly in the opposite direction to the penis, so as to keep the latter upon a slightly convex surface. They were held on by india-rubber bands, which could easily be removed for the purpose of micturition. Two or three minor operations were usually required to obtain the best possible results. The cases, in which the imperfection of development is so great as to leave the genital organs in a condition resembling that of the female sex, require more extensive operations, but these are usually more directly and completely successful than those last described.

The result in the last case operated on by the writer, six months ago, was more than usually favourable. It occurred in a young man about twenty-one years of age who, up to the age of eighteen, had been trained and dressed as a female. It was not until the voice changed and the appearance of a beard and whiskers that suspicions were aroused as to his real sex. The penis was about the size of that of a boy of ten years, and the glans fairly formed and developed, but imperforate. The urethra was open as far as the perineum, the scrotum split into two labia majora, in each of which an oval, very movable, testis could be felt. When pressed upon, these gave to the patient the testicular sensation felt by a male subject. At the posterior extremity of the urethral groove was a lunated fold, with the general appearance of the fourchette and hymen. The aperture leading to the bladder was rather larger than the diameter of the prostatic and membranous urethra in a male of that age, but the compressors of the urethra were present, and acted completely in the retention of the urine. The urine escaped in a diffuse stream from the orifice, and the patient was obliged to sit down like a female to pass the water with comfort. On examination *per anum* no uterus or vagina could be felt, but the prostate, traversed by the sound when introduced, could be distinctly made out. The nymphæ were fairly represented by the folds of the split prepuce. An attempt was first made, by paring these folds and the sides of the urethra down to the perineum, to unite them simply in the median line over a gum elastic catheter, by the use of thin silver wire sutures closely applied. This plan, however, totally failed. A second operation was more successful.

This consisted in dissecting up each of the halves of the scrotum freely, along the whole length of the sexual opening, laying down one flap, reversed, upon the urethral groove (denuded of skin on each side), and placing upon its raw surface the raw surface of the other side by the plan of reversed and superimposed flaps described under Epispadias: *see* Ectopia Vesicæ and Epispadias. These were closely stitched together with a large number of silver wire sutures, which were kept in for several weeks until the flaps were firmly grown together. Some straggling hairs, growing from the skin surface of the reversed flap, were destroyed by the application of a drop of strong nitric acid applied to the root of each hair, which removed them before the principal operation was done. The union took place all the way up to the glans penis, forming a very perfect substitute for the lower urethral wall.

The patient could pass his water over the clothes in a very fair stream, with some dribbling towards the end of micturition. The testes remained in the folds of the scrotum on each side of the perineum, and gave no trouble. The whole appearance of the genitals now left little doubt as to the sex of the patient.

Operations of the kind just described require on the part of the patient much confidence and some powers of endurance; and on that of the surgeon much previous consideration, ingenuity, and fertility of resource. Repeated attempts will often succeed in the long run, when the case appears to be hopelessly incurable. With care and caution in arranging the operation, the patient need rarely be left in a worse, even if he do not attain to a better, condition through the efforts of the surgeon.

John Wood.

HYSTERECTOMY. *See* Uterus, Extirpation of the.

I

ICHTHYOSIS.—*Definition.*—A general disease of congenital origin, characterised by extreme dryness of the skin, and more or less development of scales, epidermal plates, or warty-looking growths.

Etiology.—The disease is due to some congenital defect in the cutis, and is hereditary in many cases, but by no means in all The heredity may be direct, may skip a generation, or may be through a lateral branch. Sometimes, only one child in a large family will have it; at another, several children in the family, often keeping to the same sex, which may be either the same or the opposite to that of the affected parent; but, taken as a whole, both sexes and all classes are equally liable to it. There is no other known cause for the congenital affection, but a local condition resembling I. simplex is sometimes seen after injuries or disease of nerves. Epidermal and papillary hypertrophy is also seen sometimes in chronic inflammatory conditions looking like ichthyosis, but these are referable to elephantiasis arabum.

Varieties.—Ichthyosis, in one or other of its forms, is a fairly common disease, but varies immensely in its development. Three clinical types may be recognised: the first two are general, and are called xeroderma and ichthyosis simplex; the third, ichthyosis hystrix or hystricismus, is usually more or less localised. All of these varieties are congenital. The two general forms are not really distinct, the milder form being connected by every gradation with the more severe, but their separate consideration makes the clinical description clearer.

Symptoms.—Xeroderma is the commonest and mildest form; in it the skin is dry, rough, and dirty-looking, with the natural lines more marked than usual from the thickening of the epidermis; the roughness is produced by slight furfuraceous scalyness, and also by the prominence of the hair-follicles due to the condition known as keratosis pilaris, which is always present, often in a high degree, on the extensor surface of the limbs and trunk.

In ichthyosis simplex the whole surface has a tessellated appearance, from being covered with large, angular, dirty-white, finely corrugated, papery scales, which are adherent, and therefore slightly depressed in the centre (I. scutellata of Schönlein), while the edges are detached, transparent, and shining (I. nacrée of Alibert, or I. nitida). This and the following variations are often best seen on the leg, where the surface is frequently glistening above, with thicker scales below. In still higher grades, the scales adhere together to form thin plates, and being of a green tint look something like a serpent's skin (I. serpentina); when there are still thicker plates the appearance of a crocodile's hide is produced (Sauroderma). The older the plates, the darker they become, so that they may vary from an olive green to black (I. nigricans). A form of seborrhœa is sometimes called I. sebacea. While all these fanciful names are to be met with in literature, and are therefore explained, their use should be avoided as they only produce confusion. These extreme conditions are rarely extensive, and only occupy certain regions, a milder form prevailing elsewhere.

Although a general disease, it is unequal in its severity in different regions, and is always more developed on the extensor surfaces, especially over the tips of the elbows and knees and just above the ankles, where it may attain to the higher condition of warty growths or plates, even when the disease is moderate elsewhere; on the other hand, the flexures are comparatively free, often appearing quite normal. The palms and soles are often not much affected, except in the worst cases, but are nearly always harder and smoother from the absence of the smaller natural lines; the limbs are worse than the trunk, and the legs than the arms. The nails may be pitted and brittle, the hair is dry and harsh, and the scalp branny, while the face, though relatively less affected, is rough, and very often eczematous. In bad cases, there may be ectropion from contraction of the dry skin.

Itching is frequently experienced, especially when the clothes are taken off, but it is never severe unless eczema is present, to which the ichthyotic skin is very liable when exposed to cold, which may also produce painful fissures or chaps. The fully developed ichthyotic skin does not perspire sensibly, but some sweat may be seen in the flexures, especially the axillæ, and occasionally on the palms, soles, and face; the patients feel much relieved by it, and their condition is usually notably ameliorated in the summer.

Ichthyosis hystrix differs in so many ways from the other forms, that many regard it as a totally different affection, but there are connecting links with the commoner forms.

It is never general, though it may be widely distributed, and occasionally certain parts may be in the hystrix condition, while the rest of the skin may be xerodermatous; but in the majority of cases the intermediate skin is quite healthy. Moreover, it is seldom symmetrical and is often unilateral—sometimes sharply limited on the trunk by the median line—and frequently recognisably distributed in the course of the cutaneous nerves; hence it is usual to see it in lines running longitudinally on the limbs and transversely on the trunk, while the face is rarely affected, and then in a minor degree; in other cases the nerve-distribution cannot be traced.

The lesions vary from a small pin-point-sized papillary growth, covered with a horny cap which forms a nail-head-like prominence on the skin, up to warty or dark greenish, vertically striated, horny masses, with a wide base and truncated conical shape like limpet shells, projecting half an inch or more above the surface; when the horny part is soaked or pulled off, hypertrophied papillæ are brought into view.

Inconvenience is only experienced when the growths are in awkward positions, such as the palms and soles, on which they are common, or when the horny tops are torn off too roughly by catching in the clothes, &c.; but they are often shed spontaneously without any pain. Mental weakness is sometimes associated with very extensive cases of I. hystrix, and asthma is said to be more frequent among ichthyotic patients. In a unique unilateral case of Dr. Church's the mucous membrane of the cheek, soft palate, and tongue was affected on the same side; but for this exception it might be said that ichthyosis never affects the mucous membranes, the so-called 'ichthyosis linguæ' being an acquired affection of a totally different origin.

Course.—Although doubtless congenital, the skin does not usually show any abnormality for some weeks or months after birth, though a few cases have been born with it; while the higher grades are not attained to before the second year or later. This does not apply to I. hystrix, which develops sometimes quite early, and even at birth may show some signs of its presence. The disease tends, on the whole, to get gradually worse rather than better as the patient grows up, though there may be some remissions according to the season and to the amount of attention given to the skin. After full adult age is reached, some improvement appears to take place in cases of moderate severity.

Pathology and Morbid Anatomy.—There is evidently some congenital defect in the development of the cutis, chiefly of the epidermal layer; this is saying little, but we are unable at present to go further.

The morbid anatomy of ichthyosis simplex has not yet been made out; that of I. hystrix has been investigated by Kaposi and the author. The author's observations are here given:—In a horny growth the papillæ and their vessels are much enlarged, the Malpighian cells adjacent to the papillæ being normal, but instead of the intermediate layers of cells which in health fill or, so to speak, level up the inter-papillary spaces and so form a nearly plane surface on which the horny layers rest, the strata of horny cells dip deeply down into the inter-papillary spaces; so that the hyperplastic corneous layer follows the outline of the papillary layer, with a comparatively thin layer of rete cells intervening, in this particular differing from ordinary warts.

Diagnosis.—The diagnosis seldom presents difficulties. The disease dating back from a few months after birth; the general distribution; the dry, rough skin of xeroderma, the scales and plates of I. simplex, and the warty growths and nerve-distribution of I. hystrix are so characteristic as to leave no room for error, and the date of its onset will distinguish it from those secondary local conditions which resemble the congenital cases. When, however, extensive eczema complicates xeroderma, there is a great resemblance to prurigo, the more so as prurigo also commences in the first year of life; but the date of the onset of the eczema, the absence of prurigo papules and the enlarged glands, together with the result of treatment, will get over the difficulty.

Prognosis.—The prognosis is decidedly bad for its curability. Temporary amelioration can always be afforded in I. simplex, and, if the patient will take the daily trouble, the skin can be kept supple and free from discomfort. In very mild cases, steady perseverance for years with judicious treatment has effected a cure. I. hystrix is very hopeless as a rule, but a permanent removal of the growths, where the development has not been very great, may sometimes be effected.

Treatment.—This must be directed to removing the scales, and then making and keeping the skin pliable.

The first indication is best fulfilled by alkaline and bran baths, and friction in the baths, preceded, in bad cases, by soft-soap inunctions; the removal of the scales must be followed by inunctions of glycerine ointment or lotions, and animal and vegetable fats, vaseline or other petroleum fats. Almost any fat will do, such as lard, cold cream, neat's-foot, olive, and almond oils, or cod-liver oil; the last is very effectual, but too disagreeable. Kaposi speaks very strongly in favour of a 5 per cent. napthol ointment, in conjunction with napthol soap. Whichever is selected should be well rubbed in twice a day at first; but glycerine lotion will be found the most convenient application for the face and hands, in the strength of 1 to 10. Steady employment of these applications will soon render the skin quite smooth and supple, and the patient will seem to be quite cured; but this state can only be maintained by inunctions two or three times a week and frequent baths, or the disease will very soon return, and only requires time to resume its former severity. Eczema as a complication requires treatment appropriate to that condition; callosities can be softened by strong potash lotions (1 to 2) or continuous applications of soft soap or salicylic acid plaster. The larger growths of I. hystrix should only be interfered with if they are in inconvenient positions, and can then be excised or scraped with a sharp spoon.

The smaller papillary growths may be removed by the continuous application of tar ointment, and though many of them return, some will be permanently removed. A pleasanter application, and one which has been more successful than tar in the hands of the author, is to paint the growths, after removing the horny caps, with a saturated solution of salicylic acid in alcohol. Internal treatment in all forms is absolutely useless. H. Radcliffe Crocker.

ILIAC ABSCESS. *See* Psoas Abscess.

ILIAC ANEURISM.—The term 'iliac aneurism' is applied to all aneurismal tumours in connection with the common, external, and internal iliac arteries. The disease is most common in the lower part of the external iliac artery, at its junction with the femoral ('inguinal aneurism'). The internal iliac is rarely affected.

Etiology.—The causes are those of aneurism in general. Syphilitic disease of the vessels appears, however, to be a relatively frequent source of the lesion, while a history of a violent strain, as in lifting heavy weights, or some other traumatic influence, may often be traced. It is most commonly found in men, and about the middle period of life.

Symptoms.—The first sign usually noticed by the patient is the appearance of a pulsating tumour in some part of the iliac fossa, in the course of the common or external iliac artery. The form of the tumour is generally oval, but, when encroaching upon the common femoral, it may present a constriction at the level of Poupart's ligament. Thrill and bruit are distinct, and the latter may often be traced for a considerable distance along the femoral vessels. Pain is usually slight or absent in the deeper aneurisms, owing to the space available for the expansion of the tumour without interference with important structures; and hence the disease may reach an advanced stage, or the sac may even rupture, while the patient is still unconscious of its existence.

The condition mostly terminates by the bursting of the aneurism either internally or, more rarely, externally. In a recent case published by Mr. Gem, the hæmorrhage took place into the bladder (*Lancet*, Nov. 15, 1884). Gangrene of the limb has been recorded in one instance.

Diagnosis. — The characters of the aneurism are generally so well marked that little doubt can be entertained as to its nature. There are, however, two comparatively rare conditions which may be mistaken for the arterial disease—namely, pulsating tumour of the ilium and glandular or other growths in contact with the vessels. Pulsating tumour of the ilium is distinguished from aneurism: (1) by the extent and position of the area of the growth, which is commonly traceable on the outer as well as on the inner surface of the bone, and external to the course of the arteries; (2) by the diffused character of the bruit, which spreads widely over the iliac fossa but does not extend along the course of the arteries of the thigh; (3) by the absence of the comparative enfeeblement of the femoral pulse observable on the affected side in the case of iliac aneurism; (4) by the possibility, in some instances, of tracing the pulsation of the artery by the side of the tumour.

A group of cancerous glands in the pelvis, compressing the three iliac arteries, has been known in one case, recorded by Mr. C. H. Moore, to cause symptoms so closely resembling those of iliac aneurism that the common iliac artery was ligatured, and the real condition was not discovered until the post-mortem examination (*Med. Chir. Trans.*, vol. xxxv.).

In rare cases, an aneurism of the abdominal aorta may descend into the iliac fossa even as low as the groin, as in an example reported by Letenneur. Arteriovenous aneurisms of the iliac fossa are extremely rare, only two cases having been narrated.

Treatment.—The cure of iliac aneurism has been attempted (1) by compression applied to the tumour itself or to the vessels above the point of disease; (2) by ligature, both distal and proximal; (3) by galvanopuncture; and (4) by injection of perchloride of iron.

1. *Compression.*—Owing to the position of the iliac arteries at the back of the false pelvis, the application of pressure, if long-continued, is less easily tolerated by the patient and is attended with more difficulty and danger, than in the case of compression of vessels in the extremities. The dangers attributed to the operation are those dependent upon the contusion of the peritoneum and viscera lying in front of the vessel. It has even been questioned by Mr. Holmes whether the measure is not more dangerous than ligature of the common iliac artery; but the statistics, for which we are indebted to the same authority (*see Lancet*, Oct. 10, 1874), do not lend countenance to this view. Of ten cases of compression for iliac and ilio-femoral aneurism, seven were cured. In the other three instances no beneficial effect was produced, and ligature was subsequently applied (in one case to the abdominal aorta) with fatal results, but the unfortunate termination does not appear to have been conduced to by the previous treatment.

The compression cannot usually be maintained for more than five or six hours, even with the aid of anæsthetics; but in one case it was applied for over ten hours, and was crowned with success just as the extreme limits of tolerance were reached. Direct compression of the aneurism by means of a bandage, associated with the application of ice, was tried in one case by Raynaud, in 1835, and effected a complete cure.

2. *Ligature.*—Iliac aneurism has been treated by proximal deligation of the external and common iliac arteries and of the abdominal aorta; by distal ligature; and by a modification of the operation of Antyllus.

(*a*) The external iliac artery has been tied many times for aneurism involving the lower part of this vessel and the upper part of the femoral artery. Of 141 examples of the operation collected by Rabe and Barwell (of which about three-fourths were for femoral aneurisms), 31 terminated fatally from various causes, including secondary hæmorrhage (15), gangrene, suppuration of sac, tetanus, pyæmia, &c.; but there is good reason to believe that this mortality would be largely diminished by the resources of modern surgery.

(β) Ligature of the common iliac artery was first employed for iliac aneurism by Valentine Mott in 1827, and has since been frequently practised, but with indifferent success. Of 36 cases collected by v. Kümmell, only 9 survived the effects of the operation, the rest (75 per cent.) dying from secondary hæmorrhage, peritonitis, pyæmia, gangrene of the limb, and other causes. To the list may now be added a successful case by Stetter. In one case recorded by Sands the patient recovered at the expense of the limb, which became gangrenous after the operation. The results so far are not very encouraging; but, as remarked by Mr. Holmes, there is little doubt that, in future, the procedure will be rendered less fatal by the use of antiseptics and drainage, and by the employment of animal ligatures.

(γ) Ligature of the abdominal aorta is an heroic measure that has hitherto been uniformly disastrous. It has been performed seven times, including one case of temporary deligation, the operators being Sir Astley Cooper, James, Murray, Monteiro, South, M'Guire, and Stokes. In the case of Monteiro, the patient did not die until the eleventh day after the operation, when he succumbed to hæmorrhage, which was afterwards found to proceed from an aperture in the artery above the ligature. This case, although ultimately a failure, may be regarded as a proof that the operation is not necessarily fatal. In M'Guire's case the left ureter was included in the loop.

(δ) Ligature on the distal side of the tumour has been performed four times, in all without success.

(ε) Ligature of the artery above and below the sac, followed by the deligation of the internal iliac, which appeared to communicate with the aneurism, was performed by Syme with a curative result, but the operation has not been repeated.

3. *Galvano-puncture* was tried by the writer in 1878 in a case of aneurism of the external and common iliac. The patient, a man aged 35, was the subject of mitral and aortic valvular disease. The tumour, fusiform in shape, and about the size of a large turkey's egg, extended downwards nearly as far as Poupart's ligament, and was in process of rapid development during the period of observation. After a fruitless and ill-borne attempt at compression, it was determined to essay galvano-puncture in preference to ligature of the common iliac, as there was reason to believe that the coats of that vessel were extensively diseased. Two needles, connected with the positive and negative poles of a Stöhrer's battery of twenty cells, were introduced into the lower part of the sac, and the current was maintained for three minutes, after which the needles were left *in situ* for forty-eight hours. No immediate effects were apparent, but at the end of the second day consolidation had evidently begun, and twenty-four hours later the impulse was almost imperceptible. At this time the patient unfortunately took advantage of the temporary absence of his attendant, and got out of bed to avoid the use of the pan; on the next morning the pulsation was again distinct, and shortly afterwards regained its original force.

In cases where the aneurism is superficial, especially in the ilio-femoral form, the use of galvano-puncture in association with compression would probably favour coagulation in a marked degree without adding sensibly to the risks of pressure. It is suggested that well-insulated gold or platinum needles, one or more in connection with each pole, be introduced into the centre of the tumour, and the needles, after the discontinuance of the current, left in place for forty-eight hours or longer, during which period the galvanism may be repeated if necessary. *See* Electrolysis.

4. *Injection of Perchloride of Iron.*—This measure was adopted in the case just cited, when the tumour was enlarging with such terrible rapidity that rupture appeared imminent. A drachm of diluted liq. ferri perchloridi (1 in 4) was injected into the lower part of the sac, while the common iliac and common femoral arteries were firmly compressed. On removal of the pressure thirty minutes after the operation, the aneurism was found completely consolidated. The limb was powerless, insensible to touch below the level of Scarpa's triangle, blanched, cold, and pulseless, but there were no constitutional effects beyond a slight and transient shock. The extremity remained in the same condition day after day; the temperature was reduced by several degrees, and no indications of returning circulation could be detected; nevertheless signs of gangrene were equally absent, and the health of the patient underwent steady improvement. The sac remained solid, but was rather hot and tender.

The patient was kept in absolute repose, with the limb slightly flexed and enveloped in a thick covering of cotton wool. At the end of ten days, the area of sensibility began to extend downwards, reaching nearly as low as the knee, an increase of the local temperature was perceptible, and the constitutional condition was more satisfactory than at any time since admission. On the evening of the sixteenth day, a sudden and apparently causeless change took place. The patient became suddenly collapsed, and rapid gangrene set in, spreading as high as the hip. The extremity was amputated at the hip-joint without loss of blood, and the scanty and imperfectly vitalised flaps were washed with a strong disinfectant solution. As a result, the patient rallied to a great extent from his prostration, and for a time appeared to struggle for life with some prospect of success; but his powers were insufficient to support the profuse drain which ensued at the seat of operation, and he died of exhaustion ten days after the removal of the limb. No autopsy was permitted.

The termination of this case was unfortunate, but the results of the two powerful measures were not wholly discouraging, especially when the extent of the arterial disease and the complication with a serious cardiac lesion are borne in mind. There is little doubt that had the patient observed the injunctions strictly impressed upon him after the galvano-puncture, a complete cure would have been achieved, as in a case of axillary aneurism that had been treated in the same manner a few months previously. The injection of perchloride of iron produced an immediate consolidation of the aneurism, and although the collateral circulation was gravely compromised, the limb maintained a hopeful struggle for existence until some accident, probably the occlusion of the chief of the still permeable channels by a detached fragment of clot, inflicted the *coup de grâce.*

Amputation at the hip-joint has not yet been suggested as a means of treatment in iliac aneurism, but the expedient is perhaps worthy of consideration, as an alternative for ligature of the abdominal aorta, in cases where deligation of the common iliac is ineligible. The removal of the lower extremity would permanently lessen the circulation through the diseased vessel, and would confer all the immediate advantages of the distal ligature. At the same time the danger of the operation would be small compared with that of the aortic ligature, while, in the event of a failure to secure the desired result, the internal iliac might be tied, and the more formidable measure of ligature of the aorta would remain open as a last resource.

William Anderson.

ILIAC ARTERIES. — The Common Iliac Artery extends from the bifurcation of the aorta at the left side of the fourth lumbar vertebra; the vessel then passes downwards and outwards across the fifth lumbar vertebra, until it reaches the sacro-iliac synchondrosis, where it divides into its terminal branches—the external and internal iliacs.

Each common iliac averages two inches in length, but may vary from three-quarters of an inch to three inches. There is but little difference between the lengths of the right and left artery. I. *In front of* the right artery are—the peritoneum; the ileum just about to enter the colon at the ileo-cæcal valve; the ureter crossing just at the arterial bifurcation; sympathetic cords on their way from the lumbar ganglia to the hypogastric plexus; the ovarian artery and vein in the female. *Behind,* are the meeting of the right and left common iliac veins, and the commencement of the inferior vena cava in front of the fifth lumbar vertebra. To the *outside* is the psoas muscle; the inferior vena cava emerges from behind it to appear on the right. To the *inside* is the interval between the two common iliacs, where the left common iliac vein crosses, the arteria sacra media descends, and the hypogastric plexus is found. II. The left artery has—in *front,* the peritoneum, the ureter, and sympathetic nerves, as on the right; but the sigmoid flexure crosses it to become the rectum, with the trunk of the superior hæmorrhoidal vessels. *Behind* are the fifth lumbar vertebra, and the left common iliac vein running to the inner side and on a plane posterior to that of the artery. The other relations are almost identical.

The External Iliac Artery extends from the sacro-iliac synchondrosis to Poupart's ligament. This vessel always presents a curve in the centre of its course, being the spot where the flexure of the vessels comes in the sitting posture; this is sometimes so pronounced that it arches down into the pelvis. In *front* of the vessel, both right and left, are—the peritoneum; the ureter at the commencement of the artery; the vas deferens at the lower end; the circumflex iliac vein crosses the artery beneath the vas deferens, and close to the giving off of the deep epigastric at

Poupart's ligament; the genito-crural nerve descends upon the artery. The right artery has the ileum crossing to become the colon, the left the sigmoid flexure to become the rectum. The psoas muscle is first to the *outer* side and then at Poupart's ligament *behind* either artery—i.e. the vessel lies on the psoas at the groin. The *vein* on the left side is to the *inner* side of the artery all the way along; the vein on the right side is, at and above Poupart's ligament, to the inner side of the artery, but it then crosses beneath it to reach the common iliac vein, to form the inferior vena cava.

THE INTERNAL ILIAC ARTERY commences opposite the sacro-iliac synchondrosis on either side, and drops down into the pelvis in front of that articulation, until it reaches the upper border of the great sacro-sciatic foramen, where it divides into two primary branches—an anterior and posterior.

In *front* are the peritoneum, the ureter, and the first stage of the rectum on the left side; *behind*, the sacro-iliac synchondrosis, separated by the internal iliac vein. The external iliac vein also, on the left side, crosses behind it on its way to form the left common iliac. *Externally*, is the pelvic wall with the obturator nerve; *internally*, the rectum and the structures in the middle line. The vessel touches the edge of the psoas at its commencement, and at its ending the upper border of the pyriformis muscle.

LIGATION OF THE EXTERNAL ILIAC.—During the operation the patient lies in a recumbent position, with the shoulders raised so as to relax the abdominal muscles.

In choosing either a modification of Abernethy's or Cooper's operation the surgeon will be guided by circumstances; and when it is uncertain what artery requires ligature, will perform Abernethy's.

I. *Abernethy's Operation.*—The cutaneous incision on the right side is commenced at a point one inch above and one inch internal to the anterior superior spinous process of the ilium; from hence it is carried downwards and forwards in a curved direction, with the convexity downwards, for a distance of four inches. The incision ends half an inch external to a point midway between the anterior superior spinous process and the symphysis pubis, and three quarters of an inch above Poupart's ligament; on the left side the same incision is made, but in the reverse direction. The structures cut through are—skin; superficial fascia, with some branches of the superficial circumflex iliac artery; there may be much or little fat; deep layer of the superficial fascia—i.e. Scarpa's fascia; the aponeurosis of the external oblique is nicked and its fibres separated; the muscular fibres of the internal oblique and the transversalis muscles are cut through, and then, the transversalis fascia being exposed, nicked, and raised on a director (a hernial director is safest), the subperitoneal fat is reached. The fingers should be used to separate the tissues after the transversalis fascia is cut. By the fingers the peritoneum, with its contents, is pulled inwards until the vessel is well exposed. Retractors now hold the margins of the wound apart, the surgeon opens the sheath not lower than one inch above Poupart's ligament, draws the vein inwards, the genito-crural nerve outwards, and passes the aneurism-needle from the vein towards the psoas-muscle—i.e. from within outwards.

Dangers.—(1) Cutting too far inwards, and thereby wounding the deep epigastric; if this vessel be wounded, tie it. (2) Wounding the peritoneum by rash cutting, or by neglecting to use the director properly. (3) Failing to find the vessel in the usual position; if it is not normal, it will be found bent downwards towards the pelvis. (4) Wound of the circumflex iliac vein. (5) Including the genito-crural nerve, giving rise, according to observation, to tetanus. (6) The subsequent dangers are—gangrene of the lower limb, secondary hæmorrhage, sloughing of the sac, tetanus and peritonitis.

II. When it is known what the exact extent of the disease is and where the ligature is to be applied, Sir Astley Cooper's operation may be performed. Make an incision through the skin from just external to the external abdominal ring to near the anterior superior spinous process of the ilium. The incision will be about three inches long and parallel to the fibres of the external oblique muscle. Cut through the integument, fasciæ, and external oblique, slitting it parallel to its fibres. With the director separate the deeper tissues from Poupart's ligament, drawing the spermatic cord and epigastric artery upwards and inwards, and the internal oblique and transversalis muscles upwards and outwards. Tear through the transversalis fascia, when the peritoneum is raised by both the retractors and the vessel is seen and secured, as in the operation previously described.

Dangers.—(1) Finding that the disease is of greater extent than diagnosed, which, on account of the limited space given by the incision, makes it difficult to reach the sound artery. (2) Wounding the deep epigastric; this is to be immediately tied.

III. The so-called Esmarch's operation is practically a systematised Abernethy.

The Common Iliac Artery is ligatured by precisely the same incision as that employed in Abernethy's operation, only that the external limit of the incision given above is continued upwards towards the cartilages of the ribs for a distance of three inches. In other words, an incision is commenced just in front of the cartilage of the eleventh rib, and carried downwards and forwards to one inch and a half within the anterior superior spinous process of the ilium, and terminating by a sharp curve inwards just above the internal abdominal ring. The tissues cut through and retracted are the same as those met with in Abernethy's operation. The retraction of the tissues is continued until the pulsations of the external iliac can be felt, when the finger is run upwards, detaching the peritoneum, until the common trunk is reached. The needle is passed from within outwards on both sides.

Dangers.—Wounding the peritoneum, either when cutting down on the vessel or when it is being raised. To avoid wounding it open the transversalis fascia low down, where it is strongest, and, as the process of detachment is proceeding, gently but firmly support the parts, holding the peritoneum well out of the way. During the detachment the ureter clings to the peritoneum, and is pulled inwards with it. See also *External Iliac Artery* above.

The Internal Iliac Artery can be reached and ligatured by steps identical with those employed for the common iliac. Steven of Santa Cruz, however, who first tied the vessel, reached it by making an incision five inches long and half-an-inch outside of, and parallel to, the deep epigastric artery. Another incision has been employed, but with many evident disadvantages; it is an incision practised by White, commencing two inches to either the right or left of the umbilicus, according to the side required, and cutting downwards and inwards by a curved incision, with its convexity towards the ilium, and ending just above the external abdominal ring. James Cantlie.

IMMOBILITY, or absolute rest, is one of the most potent factors in the healing process of bruised or broken, diseased or wounded, hard or soft tissues. As a therapeutic principle, immobility underlies the whole surgical domain. It is one of the fundamental and most generally applicable lessons of physiological surgery, and one of the chief aims of surgical handicraft and mechanics; especially so in the treatment of wounds, sprains, and fractures, and of articular diseases. Repair is in direct proportion to rest; and the nearer this approaches to immobility, the more perfect will be the work of reparative surgery. Physiological position and equable pressure powerfully contribute to immobility; but, as a rule, this cannot be secured without mechanical contrivances. Of these, the best and most generally useful are moulds and splints, enclosing the joints above and below the point to be immobolised, sand, shot, and water-bags, weights, pulleys, and swings. For the construction of moulds, a great variety of materials are available —millboard, gutta-percha, paraffine, and poro-plastic felt, starch, dextrine, silicate of potash, plaster of Paris, and strips or sheets of wood and metal. The surgeon's choice must be regulated by the exigencies of particular cases, and by his opportunities of acquiring experience with different kinds of materials and methods. Wire moulds are easy of construction, and may be made strong, yet light. Another simple and efficient plan for immobilising a limb, or the trunk, consists in padding well, and then adding diagonal strips of moistened millboard or plastic felt, thin metal or deal veneer or scaleboard. Bandaging, lightly yet firmly, smoothly and without reverses, commences when the first strip is laid on. Successive strips and layers of bandage follow, until a perfectly fitting and comfortable mould is constructed, with all the strength possessed by alternately intersecting spirals. The addition of gum, starch, chalk, or other solidifiable material, over the layers of the apparatus in process of construction, materially contributes to its strength. Rigid splints and moulds, however constructed, may often be usefully combined with undulating suspension, in securing immobility; illustrating how in the treatment, as in the production, of injuries and diseases, a combination of causes, seemingly, but not essentially, different, may contribute to common ends. *See* Position; Pressure; Rest; Suspension.

Sampson Gamgee.

IMMOBILISATION. *See* Immobility.

IMMOVABLE BANDAGES.—The essential principle in all the substances used for immovable bandages is, that they can be applied in such a soft and pliant state as to be accurately adapted to the shape of the part, and that, when they have set, they form a firm and even support for every portion of it. The most important materials used are bandages soaked in starch, dextrine, plaster of Paris, a mixture of gum and chalk, glue, silicate of potash or soda, paraffin or bees' wax; coarse flannel soaked in plaster of Paris; gutta-percha, leather, and poro-plastic felt. They are used to maintain accurate position and immobility of broken bones and excised joints, to secure perfect rest of diseased joints, to make spinal supports, to rectify deformities of joints, &c., and to fix interrupted metal splints in compound fractures, excisions, &c.

Some form of immovable apparatus is usually employed as a final support to fractures, but opinions differ with regard to their immediate treatment in this way; the only valid objection to it appears to be the danger of the limb swelling and causing localised sloughs or gangrene; but if the patient be watched for a few days, there need be no alarm on this score, for any swelling and blueness of the toes, or pain from the apparatus, should lead to its instant removal and the relief of pressure. There are, moreover, a number of advantages resulting from this method of treatment; perfect immobility is secured at once, so that pain and laceration of tissues resulting from muscular spasm are prevented, and the bones are placed in the most perfect condition for rapid union; the apparatus is so comfortable that it is unusual to have complaints of uneasiness, even from fidgety patients; the irksomeness of a fixed position is obviated, for the patient is able to turn about when the apparatus is set, and in the course of a few days he is able to get up and out into the open air; his stay in hospital is much diminished, and, if his occupation is suitable, he is very quickly enabled to attend to it in some degree.

PLASTER OF PARIS BANDAGES.—The finest plaster, such as dentists and modellers use, is required; it must be freshly prepared, for any dampness will interfere with its 'setting;' and, if there is any doubt about its condition, it should be baked in an oven, so that it may be again rendered fit for use. The best bandages for this purpose are made of crinoline, the meshes of which are sufficiently large to allow of the plaster being well ground into them, but not large enough to let it fall through; it is very important that the plaster be well ground into the meshes, and that any superfluous powder be rubbed off, for if left it makes the bandage lumpy. The bandages should be rolled up loosely, and if not used all at once they should be placed in an airtight box, or they will quickly spoil. If there be no fear of swelling, the limb should be first covered with a flannel bandage; but if swelling be expected, as in a case of recent fracture, cotton wadding should be used by preference, as that will yield a little in the event of swelling occurring, whilst at the same time it exercises an elastic pressure on the limb, and also expands again as the swelling subsides. Place a bandage on end in a basin of warm water till it is saturated and all bubbles have ceased to rise, then squeeze out the superfluous water, and apply the bandage by spiral and oblique turns, rapidly ascending and descending the limb, till the whole is covered in. The oblique turns have the advantage that they lie quite evenly, without reverses, and run more nearly in the length of the limb, and so ensure greater strength and less liability to transverse cracking of the apparatus. While one bandage is being applied, another should be placed in the water to soak; as a rule, three or four thicknesses of bandage will suffice; reverses should not be used, but the final layer may be put on by figure-of-eight turns, so as to give a neat appearance to the splint. The whole apparatus may be smoothed over with plaster-cream, but the folds of the bandage should not be effaced by it. If greater strength be required, strips of wood or perforated tin may be placed between the layers of the bandage. If a window be required, the situation should be indicated by some contrivance, and a good one is to take a piece of card of the requisite size, prick a pin through the centre of it, and place it, with the pin projecting outwards, over the required spot, and as the bandages are rolled over that part, make the pin pass through them and stand off from the surface, as an indication of the centre of the area to be cut out from the plaster case.

BAVARIAN SPLINT.—Take two pieces of flannel, long enough to reach from the ham to the ball of the toes, and a few inches wider than the circumference of the leg, stitch them together along the middle line for the length of the leg, and beyond this cut them through in the same line; put the flannel behind the limb, with the seam exactly in the middle, bring the inner layer round and pin it along the front of the leg, the dorsum and sole of the foot, so as to form a tightly-fitting stocking; smear this layer all over with plaster of Paris cream, and before it sets, press the outer layer, already cut to the proper size, evenly over it. When the plaster has set, remove the pins from the inner layer of flannel, and bring the borders of the latter round the edge of the splint in front and along the sole, and stitch it to the outer layer. The apparatus forms an accurately-fitting splint, which can be easily removed without in any way disarranging the limb, as the seam along the back of it acts as a perfect hinge.

Croft's Splint, for the immediate treatment of fractures of the leg, consists essentially of two well-moulded lateral splints, made of coarse house-flannel, thoroughly soaked in plaster of Paris cream ; the flannel should be thoroughly shrunk, and from it four pieces, having the shape of the patient's stocking, and long enough to reach from just above or just below the knee to the middle of the metatarsus, should be cut, particular care being taken that the foot-piece is at right angles to the leg-piece, and also that the anterior border of the latter is a straight line. Arrange the four pieces of flannel in pairs—two for each side of the leg—and saturate the outer piece of each with plaster a little thicker than cream, and re-apply it to its fellow. The splints ready, the patient should be anæsthetised if necessary, the leg ' set,' and held in position with the foot at right angles to the leg, the splints applied and fixed by simple plaster of Paris bandage. The apparatus may be easily cut down the front, if need be, the edges trimmed, and the splint eased or tightened as required. If a window be needed, it should be cut in the flannel before it is soaked in the plaster of Paris cream.

Starch Bandages are used for similar purposes to plaster of Paris ones, over which they have the advantage of lightness, but the disadvantages of requiring a longer time to dry, and of not forming so strong a support. Prepare a bowl of hot ' clear starch,' and pass well-shrunk calico bandages through it, and re-roll them ; next envelope the limb evenly with a layer of cotton wadding, and smear the latter with starch ; then take pasteboard splints, which have been torn to the requisite size and shape, steep them in boiling water and then in starch, and whilst still hot, apply them to the limb outside the cotton wool, and fix them in position by a turn of bandage here and there. Let the limb be held in position, and then apply the starch bandages, and, as they are rolled, let more starch be rubbed into them by hand, or painted on with a brush ; reverses should be avoided, as they cause uneven pressure, and add considerably to the difficulty of cutting up the bandages. When dry, the starch apparatus is often too loose, and if so, it should be cut up the front, and the edges pared and brought close together by another starch bandage.

Paraffin forms a light, non-absorbent splint, and has the advantage that it can be recovered from an old splint by steeping it in boiling water, when the paraffin will rise to the top and solidify there as the water cools. The paraffin should melt at from 120°–130° F. To make a splint of it, bandage the limb with a flannel roller, and over it apply a few layers of strips of flannel soaked in the molten paraffin. It is best to put on the paraffin in strips, like strapping, as it sets too quickly to be applied in a continuous bandage. Macewen's method is perhaps still better, and easier of application ; he takes a piece of sheet cotton-wool, cut so as to ensheath the limb accurately, and steeps it in melted paraffin ; he then applies a gauze bandage to the limb, adjusts the paraffin splint, and puts another gauze bandage rather firmly outside all.

Silica, or Liquid Glass, Bandages may be kept ready for use in bottles of the silicate solution. They ' set ' sufficiently to restrain movement in less than an hour, but require two or three days to harden completely ; they can be easily removed, as the silicate is soluble in water.

Gum-and-Chalk Bandages are applied in the same manner as the starched ones, over which they have the advantage of ' setting ' more quickly, and forming a firmer splint ; equal parts of gum arabic and precipitated chalk should be mixed up with boiling water, and the bandages passed through the mixture and re-rolled ; gauze bandages do very well.

Glue Bandages form a firm and elastic splint, which can be easily cut up about twelve hours after application, and the edges fitted with ' eyelets ' if required. Steep some fragments of the best French glue in cold water for a few hours, then melt it in the usual way, and add one-fifth part of methylated spirit, stirring the mixture well, so as to cause solution of the coagulum formed on the addition of the spirit ; the spirit accelerates the hardening of the glue. Cotton bandages should be used and, as each one is applied, it should be thoroughly brushed over with glue ; two or three layers of the bandage are usually sufficient.

Bilton Pollard.

IMPACTED CALCULUS. *See* Stone in the Urethra.

IMPACTED FRACTURE. *See* Fractures.

IMPETIGO (*Synon.* Impetigo contagiosa; Porrigo contagiosa).—The name impetigo was formerly applied to certain diseases of the skin attended with the formation of *pustules;* thus an eczema in which pustules were abundant was called impetigo. The pathological change seemed to the older writers to entitle the disease to a change of name, and the fact that pus-formation is only part of a *morbid process* which may occur in almost any inflammatory disease of the skin was apparently overlooked. In the sense above indicated, the name impetigo does not convey any very clear idea of a definite disease distinct from eczema, and therefore the name pustular eczema is to be preferred. Dr. Duhring, of Philadelphia, is the only writer of mark who describes, under the name impetigo, 'one of the rarer skin diseases' distinct from impetigo contagiosa and eczema, and says 'the initial lesion is a perfect pustule.' The writer of the present article has failed to identify Dr. Duhring's impetigo with any disease met with in England; indeed, it may be doubted whether the 'initial lesion' in any disease can be a 'perfect pustule.' The late Dr. Tilbury Fox drew a distinction between common porrigo and impetigo contagiosa; but the distinction, if any, is one of cause rather than of kind. German writers of the Vienna school, on the other hand, scarcely admit any form of impetigo as distinct from eczema; the distinction is, however, fully recognised by most American, English, and Continental writers, and is certainly convenient. The name impetigo is gradually and rightly displacing such terms as porrigo and impetigo contagiosa, which might with advantage be dropped out of our nomenclature.

Impetigo is an inflammatory affection of the skin, attended with a vesico-pustular eruption. The vesicles are usually isolated or scattered in small groups; their contents very quickly become puriform, and this is followed by rupture of their walls and the formation of thick, light yellow scabs, which completely cover an excoriated surface; the eruption is very easily reproduced by inoculation.

Impetigo is a disease which has given rise to much discussion. Many writers on the subject appear to lose sight of the fact that all pus, under certain favourable conditions, is capable of being inoculated with the result of producing more pus. The fact, that the pus of impetigo is usually more readily inoculated than other pus, depends on the surrounding influences of the case; unfavourable hygienic conditions are enough to explain the difficulty which seems still to puzzle some writers. The disease, though occasionally introduced into the schools and families of the well-to-do classes, never spreads rapidly, while amongst the crowded poor of our large towns it quickly attacks every young member of the household.

Etiology and Pathology.—The causes of impetigo are almost always local, combined with unfavourable hygiene. That the latter is an important factor is proved by the fact that the disease is almost confined to the poor, dirty, and badly-fed classes; the local cause is *pus-inoculation*, the origins of which are very numerous. Amongst the best recognised may be mentioned superficial whitlows, burns, vaccination or any slight wound that 'gathers' or 'festers,' as non-professional people are in the habit of calling the formation of pus. But by far the most common cause is pediculi capitis: here the lesions from scratching are numerous, and the pus is very easily transferred by the nails to other parts of the body, especially to the nose and corners of the mouth. In all cases the pus is quickly absorbed by the lymphatics, hence the rapid enlargement of the glands of the neck. This absorption by the lymphatics plays, in the opinion of the writer, an important part in the extension of the disease, as it does not seem possible to explain the very rapid and extensive eruption of pustules, which sometimes occurs, on the supposition that each pustule is the centre of a separate inoculation. The constitutional disturbance which often accompanies the disease also seems to point in the same direction.

Diagnosis.—The following points will especially distinguish impetigo from ordinary eczema:—(1) Each spot appears as a single vesicle or small group of vesicles, without the surrounding skin being red and inflamed, very unlike the first appearance of a patch of eczema; (2) it is easily inoculated; (3) it is usually unsymmetrical and more distinctly a local affection than eczema; (4) it is unattended with itching unless complicated with pediculi or eczema; (5) it is almost entirely a disease of the poor and dirty classes, and chiefly confined to children; (6) the children who suffer long from it are always pale and badly nourished; (7) pediculi capitis being the most common cause, it follows that the occiput is the most common primary seat of the disease; it is thence transferred to the nose and corners of the mouth and to other parts of the body, or from person to person; (8) when the occiput is affected the glands in the neck are quickly enlarged.

Treatment.— Impetigo of the scalp is quickly cured by white precipitate ointment, which heals the sores and at the same time removes the cause. On the body, the best local application is a thick lotion made of calamine, zinc oxide, and lime water; this should be painted on with a brush and allowed to dry on, so that a crust is formed. If pus collects under this crust, it should be removed and the excoriated surface painted again with the lotion; when the crusts remain firmly attached the cure is soon effected. Tonics, especially iron, are useful. Robert Liveing.

IMPOTENCE.—Incapacity for sexual intercourse must be distinguished from sterility, or incapacity for the secretion or ejaculation, at the requisite time, of normal seminal fluid. The subject of sterility is not necessarily impotent; but if we except the rare cases in which conception has occurred without penetration, impotence involves sterility.

Impotence may be congenital or acquired, complete or partial, permanent or temporary, and may result from widely different causes.

Enlargement of the scrotum, from a large irreducible scrotal hernia, or from a large hydrocele of the tunica vaginalis, or from elephantiasis, may prevent copulation. Malformation of the penis, such as extreme epi- or hypospadias, arrest of growth of the external genitals, so that they remain of infantile size in adult life, benign or malignant growths on the penis, may also prevent it. Inflammation or suppuration of part of the corpus spongiosum, or of the corpora cavernosa, sometimes results in the formation of cicatricial tissue, by which the penis may be so distorted during erection as to render penetration impossible. Induration and contraction of the frenum may have a similar result. Total loss of the penis from accident or disease necessarily causes impotence, but partial removal of the organ has not this effect, if enough be left to allow of penetration. Arrest of development of the testicles, or complete destruction of both glands from accident or disease, will usually be attended with impotence. In some cases, however, of double castration, the power of copulation has been retained for some time after the operation. Partial or complete defect of the erectile power from some abnormal condition of the central nervous system is the most usual cause of impotence. Erection is the result of a greatly increased supply of arterial blood through the temporarily dilated afferent vessels of the penis, combined with retarded outflow from the organ, in consequence of relaxation of the muscular fibres in its cavernous structures, and possibly of compression of the dorsal vein by fibres of the accelerator urinæ muscle. The process is controlled and regulated by nerves originating in ganglion cells, the so-called erection centre, in the lumbar portion of the spinal cord. This centre can be excited by peripheral stimulation of the afferent nerves of the genital organs, and possibly by the quantity and quality of the blood supplied to it. It is also connected, by fibres in the spinal cord, with higher centres in the cord itself and in the cerebrum, by which it can be excited or inhibited. These centres, with their connecting fibres, and afferent and efferent nerves, form a complex nervous system, and impotence from defect of erection, may result from disturbance of the due relation between the several parts of this system, or from injury, disease, or degeneration of it.

Impotence from the condition of the central nervous system may be classified as psychical, irritable, and paralytic.

Psychical impotence results from undue predominance of the cerebral inhibiting centres, so that erection does not occur. It is, in most cases, of only temporary duration. Newly-married men sometimes find themselves incapacitated from performing marital functions from this cause. In those who have led chaste lives, it may be due to nervousness or great excitement. But in cases where excessive venery or masturbation has been practised, the predominant inhibition may be due to diminished excitability of the lumbar centre. Patience, and the assurance that there is no physical incapacity, generally suffice to terminate this unpleasant condition. This form of impotence is sometimes more persistent, but is limited to attempted connection with one individual, and is not experienced with others. Such cases are very rare; but the story told by Herodotus of King Amasis and his wife Ladike, is corroborated by more modern apparently genuine instances. The inhibition in these cases is probably reflex, and excited by some peculiarity in the female.

In irritable impotence there is erection, but of very brief duration, and the semen is ejaculated before penetration has been effected. There may be varying degrees, and some cases are on the border line between impotence and sterility. It is due to over-excitability of the nervous centres, and generally results from habitual masturbation or excessive venery.

Paralytic impotence may be due to injury, disease, or degeneration of the nervous centres. Blows upon the head, or injuries to the back, are sometimes the cause of permanent or temporary impotence, which can only be explained by the assumption of some affection of the nervous system. Fracture of the spine, producing paraplegia, must necessarily cause impotence. If the injury to the cord be above the lumbar centre, there is usually persistent priapism, from hyperæmia or irritation of the lumbar centre, or from accidental peripheral stimulation in the absence of all inhibiting control. But even if there be no priapism, reflex erection could doubtless be produced in such cases if the lumbar centre be intact, and cases are recorded where, despite the paraplegia, copulation, and even procreation, have been effected, the man being, of course, passive in the transaction. Diseases of the cerebrum and spinal cord may also cause impotence, which is sometimes an early symptom in locomotor ataxy.

Cases not infrequently occur of premature diminution, and ultimately of total loss of virility, without any symptom of disease or history of injury. These can only be explained by the assumption of premature degeneration of the nervous centres. The duration of sexual life is very variable, in some being prolonged to extreme old age, in others terminating at a much earlier period. The latter may be due to individual idiosyncrasy, but is more frequently the result of premature and excessive indulgence in venery, or of habitual masturbation. Impotence may be a symptom of general exhaustion, temporary after acute fevers, or permanent in wasting diseases, such as phthisis. It is often associated with Bright's disease, and, in varying degrees, with diabetes. Gout may induce it temporarily, and it is often the result of disordered digestion, especially if there be oxaluria or phosphuria.

Lastly, certain drugs are credited with producing impotence. Arsenic, according to Charcot, has this effect when taken for a long time, but on the cessation of its use virility is regained. Opium-eating and excessive indulgence in tobacco are also said to produce impotence, probably from their deleterious influence on the nervous and digestive systems. Considering the prevalent use of tobacco without such results, there may possibly have been some special susceptibility to its influence in the cases where this effect has been observed.

The prognosis with respect to impotence must depend upon the cause, which can be ascertained only by careful inquiry into the history and general condition of the patient.

Treatment.—This will vary with the cause. When impotence is a symptom of some other disease, the appropriate treatment for the exciting cause must be pursued. Impotence from mechanical hindrance, such as hernia, hydrocele, benign tumours, or growths, cicatrices, and the like, may in some cases be relieved by operative interference.

Psychical impotence, as a rule, requires only moral treatment. In irritable impotence, due to previous excess, complete chastity of mind and body for a time, cold bathing, and suitable tonics, will be of great service. Easton's syrup of phosphate of iron, quinine, and strychnia, is a very useful preparation in these cases. Electricity has been highly commended, and the frequent application of a constant current to the lower part of the spine may be of service in reducing the over-excitability of the lumbar centre. In persons of naturally feeble power, so-called aphrodisiacs, such as phosphorus and the tincture of cantharides, are sometimes useful; but in cases of exhaustion from excess they are of as little service as would be the spurring a jaded horse when a long journey has still to be performed. In impotence from injury to the head or back, blisters along the spine have been recommended; but the treatment is so empirical and uncertain in its results, that it is difficult to estimate in the successful cases how much may have been due to art, how much to nature. Premature loss of virility, with retained sexual desire, is especially troublesome. Such patients are usually hypochondriacal, and sometimes develop suicidal tendencies. They appear to regard copulation as the only purpose of existence, and to have lost, with the ability to accomplish it, all inducement for living. Even in these cases, chastity of thought, exercise, cold bathing, and nervine tonics may effect some improvement. But the prognosis is not favourable, and the happiest result would be if they could be induced to adopt Cicero's philosophy, and regard their loss as gain. 'O præclarum munus ætatis, si quidem id aufert, quod vitiosissimum adolescentiæ est!'

Jeremiah McCarthy.

INCARCERATED HERNIA. *See* Hernia, Obstructed.

INCLINED PLANES are appliances by means of which broken limbs may be supported, and displacement of the bones prevented by relaxing the faulty muscles. The single inclined plane supports the lower limb with the knee extended and the hip flexed, and this has been recommended in treating fractures of the patella; it is also useful to support the limb when the venous circulation in it is impeded. The double inclined plane is so adapted as to support the lower limb with the knee and hip-joints both flexed, which position relaxes the psoas and iliacus, and prevents their traction on the upper fragment in fractures of the femur high up; it also relaxes the hamstrings and the calf-muscles, and so removes much of the cause of displacement in fractures close to the lower end of the femur. The apparatuses, to which the term inclined plane is primarily applied, are made of wood; some of them are made with fixed angles, but others have arrangements by which the angles may be altered. As a rule there are no lateral supports, but Esmarch's inclined plane is perforated by a number of holes into which pegs may be placed; when the limb is in position on the inclined plane, pegs are placed in the most suitable holes to form a barricade all along the limb, and so prevent it from slipping from its position.

McIntyre's splint and Hodgen's suspension splint are essentially inclined planes, and are more comfortable than the wooden ones above described. Bilton Pollard.

INCONTINENCE OF URINE, or ENURESIS.—In this affection the will cannot control the action of the bladder, and urine is involuntarily discharged, greatly to the annoyance of the patient, and often seriously affecting the performance of his or her social duties. In these cases the bladder is always empty, or is periodically emptied by the involuntary efforts of the patient. There is, however, a condition known as false incontinence, which it is of great clinical importance to distinguish from the true variety; here the bladder is never really emptied but is habitually full of urine, while the overflow runs off and makes the bladder appear incapable of holding any water. Such cases are at once distinguished by the use of a catheter, when the chronically retained urine is drawn off. False incontinence results from long-standing urethral stricture, chronic enlargement and other affections of the prostate, and from atony and paralysis of the bladder. In women, in addition to atony and paralysis of the bladder, its expulsive power may be seriously interfered with by certain conditions of the uterus, notably, by prolapse and retroflexion of that organ. For the treatment of false incontinence *see* Bladder, Diseases of the.

Men, women, and children may all suffer from true incontinence of urine. In men and women, true incontinence may result from defect in the primary nervous centres. When this is so, probably other organs will be affected besides the bladder. Here the surgeon can do but little. The treatment must consist of tonics and stimulants, diet, sea bathing, and the use of electricity. Vesical calculus may be the cause of constant dribbling of urine; in which case the stone is usually lodged in the neck of the bladder. In the same way prostatic calculus may cause incontinence. There is a peculiar form of chronic enlargement of the prostate, where the hypertrophy so affects the neck of the bladder that its action is rendered imperfect and urine constantly flows away, although there is absolutely no habitually retained water. Here the patient must wear an india-rubber convenience, and beyond careful attention to the bowels there is nothing to be done; fortunately such cases are of extreme rarity. At all ages, and in both sexes, incontinence may follow severe injury to the urinary apparatus, the result of kicks, falls, or tubercular or syphilitic ulceration.

Incontinence of urine, in women, may be caused by injury to the neck of the bladder or urethra, from the prolonged pressure of the child's head during labour, or from the use of instruments; and also from operations undertaken for the removal of stone from the bladder. In certain of these cases, plastic operations may be undertaken with some hope of success. After perineal lithotomy both men and boys occasionally suffer from incontinence. In children this unfortunate condition appears to come on quite independently of the size of the stone or of the roughness of the operation; but in men it appears to have some connection with the size of the stone, and the writer has known it follow the operation of lithotomy, when the wound has required firm and prolonged plugging on account of hæmorrhage. In these cases, during the night there is usually (except in children) no escape of urine, but in the daytime there is a constant leakage, the patient also making urine naturally at regular intervals. An india-rubber receptacle may be worn, or a napkin only if the escape be very slight. An attempt may be made, but it is rarely successful, to retain the urine by means of the pressure of a perineal pad, secured by a truss, or by elastic shoulder-straps or braces.

Juvenile Incontinence.—In children there is a special form of urinary incontinence, which deserves particular attention. The bladder appears to be in a hyperæsthetic condition, and children of all ages and of both sexes may pass urine involuntarily during the night and day. Usually it is in the night only, and the child wets his bed and is said to suffer from nocturnal incontinence of urine. During babyhood the habit often escapes notice, or is looked upon as almost natural, but as age advances the debility is found very distressing, and sooner or later medical aid is called in; especially when the parent finds that the child is debarred from many educational and social advantages. Generally, there is nothing remarkable about the appearance of these children, although often they are exceptionally bright and intelligent. Sometimes, the habit has resulted from neglect on the part of the mother or nurse, who has omitted to rouse the child during the many hours it is naturally in bed. In other cases the affection arises from the local irritation of intestinal worms, from a tight, long, and perhaps adherent prepuce, or from a too acid or other morbid condition of the urine. In most cases, however, it is simply a nervous debility, either the expelling muscles of the bladder are unduly active or the retaining muscles are weak, or there is a want of proper co-ordination between the two sets of muscles. As puberty arrives the weakness usually, but not always, disappears.

Treatment.—In the first place see the child make water, and note if there is pain or difficulty in the act of micturition. Be on the look-out for symptoms of stone, and even for retention of urine; the latter may be suspected if there is a suprapubic tumour, the former if the incontinence is diurnal, and if there is much pain at the end of passing water; but, if all appears to be right, do not distress the child with the use of any urethral instrument. In treating the children of well-to-do parents, remember that it is very unusual for them to suffer from vesical calculus. Next, examine the urine, look for albumen, sugar, pus, blood, and for lithates, as well as earthy phosphates. Very likely the urine will be quite healthy. Inquire if red sand is ever noticed in the child's water. Inquire also about worms: ask if any have been seen, and if any anal itching is complained of. Examine the foreskin; if it is not easily retractable, perform circumcision. This operation is universally desirable, and, should the incontinence persist afterwards, the child will in every way be in a more advantageous condition than he was before. If worms are present (usually thread-worms), remove them by means of common salt enemata and vermifuge medicine, such as santonin, followed by a brisk purge. If the urine is habitually too acid, attention must be paid to diet, and a small dose of grey powder given; afterwards a little alkaline medicine may be administered, but all diuretic salts must be carefully avoided.

In all cases the diet must be regulated. The meals should consist of breakfast, dinner in the middle of the day, and supper. All stimulants, including tea and coffee, must be absolutely interdicted. No sweetmeats are allowable, and certainly not much butcher's meat. Some have advised entire abstinence from meat and even from broths, but this does not appear to be necessary. The child should live upon bread, vegetables, fruit (in moderation), milk, any farinaceous foods, butter, eggs, fish, fresh game, poultry, and a little meat. An effort should be made towards evening to curtail or even to avoid all fluids. The general habits of the child must also be superintended. He should be warmly clothed, and the skin kept active by plenty of hot water, soap, and good rubbing. His life should be a quiet one, all excitement such as is afforded by theatres and children's parties, is to be avoided, and in many cases a diminution of the school tasks will be advantageous. In rare cases, the child may be allowed to run wild in the country or at the seaside for twelve months. All terrorism is wrong, and parents, nurses, or schoolmasters using the rod in such cases deserve a hundred times the punishment themselves. The young patient should go to bed early, and should be taken up the last thing at night and early in the morning to pass water. In the daytime he should be encouraged to hold his urine as long as possible, and at night his bed should be a hard one, and the coverings not very heavy. He should sleep on his side, and not on the back; this is often managed by tying a knotted handkerchief round the waist, with the hard central knot just over the middle of the back. The bowels must if necessary be made to act daily, easily and gently.

It is surprising how much may be done by careful management, but in many cases medicines must be resorted to. The drug most in favour, and which undoubtedly is frequently successful, is belladonna and its alkaloid, atropine. The tincture of belladonna and the extract are both used. Care should be taken that the drug is of the very best quality. It acts by partially paralysing the bladder. A small dose should be commenced with, three times a day, and gradually increased, while its effects are closely watched, so that directly any symptoms of excess are seen, such as dryness of throat and dimness of vision, its increased administration may be stayed. When the bladder is found to be controlled by this medicine, the dose is not to be further augmented, but the patient should be kept under its full influence about a week, and then the doses may be gradually diminished until the medicine is entirely left off. In the same category come the ordinary preparations of opium administered by mouth or rectum, and also chloral hydrate and the bromides. The writer has used codeia with satisfaction. These medicines act by diminishing sensibility, and enable the bladder to become tolerant of urine. On the other hand, in some cases stimulants and tonics are useful; all the ferruginous preparations, together with strychnia, cantharides, and ergot, have been largely used. It is almost needless to say that any condition of the general health requiring cod-liver oil or other special medicines must be attended to. Counter-irritation is sometimes of service. This is usually made by applying a large blister over the sacrum. The blister may be kept open by dressing it daily with savin ointment. Doubtless counter-irritation is often useful, and it is advantageous also in an indirect way, for, if applied over the sacrum, the sore place prevents the patient from sleeping on his back.

In boys the passage of a soft bougie is often beneficial, and in both sexes as a last resource a mild solution of nitrate of silver may be applied to the urethra. In boys this is done through a small catheter passed into the deep urethra. The solution at first should not be stronger than two grains to the ounce of water, afterwards the strength may be gradually increased up to eight or even ten grains. All mechanical methods of closing the urethra, by means of collodion, elastic ligatures, &c., are not recommended. In conclusion, it may be remarked that these cases are often very obstinate, and unless there is strict attention to details in the treatment, it had better not even be attempted, so far as the credit of the practitioner is concerned.

G. Buckston Browne.

INDURATION, in the majority of cases, is the sequel of inflammation. It then varies directly as the chronicity and inversely as the activity of the exudation. But the constitutional state of the patient and the intrinsic nature of the disease are very important factors in fashioning the final result. In strumous enlargement of the lymphatic glands, the degree and distribution of the induration change with the sequence of phases of the morbid process. At first the hardening is diffused, then it gives way, in the centre of the gland, to the softening of suppuration or caseation, whilst finally, the pultaceous débris not seldom becomes impregnated with lime salts, and a nodule of chalky or stony density, surrounded by close-grained cicatricial tissue, is the abiding mark of the previous disease.

Again, there are some maladies, mostly of a specific nature, like syphilis, diphtheritic croup, and croupous pneumonia, in which the exudation is highly fibrinous. The comparative induration of different venereal sores is a valuable aid to their diagnosis. It is not alone in the primary lesion of syphilis that the induration is so marked. The same holds good as regards the swelling of the lymphatic glands—indolent bubo.

Induration is one of the changes incidental to old age: thus the cranial bones become thicker and more compact from ossific deposit, and the parenchymatous organs—e.g. the brain—are subject to overgrowth of interstitial tissue. The terms *sclerosis*, *fibrosis*, and *cirrhosis* are employed to indicate indurating processes, which in former times were considered as inflammatory, but are now regarded as simple fibroid substitution—a distinction almost without a difference. Familiar examples are furnished by the so-called 'gin-drinker's liver' and by the sclerotic lesions of the spinal cord—posterior, lateral, annular, insular, &c.

It may be stated generally that the firmer the tissue in its natural state, the greater is the induration of disease: take, e.g., epithelioma of the skin, lip, or tongue, and a periosteal node in which ossification of the inflammatory neoplasia is a frequent event.

The condition known as *solid œdema* follows diffuse thrombosis of the veins and blocking of the lymph paths. It is slow to disappear, and in marked cases, where many vessels are obliterated by organised clots, there is permanent induration and enlargement of the part. The resistance to pressure in phlegmasia alba dolens may be compared with the easy pitting in serous œdema from renal or cardiac disease.

The degree of the induration aids, as before said, in the differential diagnosis of venereal sores. It is likewise called into requisition when a doubt exists as to the cancerous or syphilitic nature of an ulcer of the tongue. In each there is hardness due to inflammation, but in cancer there is added that from cornification of the epithelial cells. A periosteal node is simulated by erythema nodosum, but the former is much the harder of the two.

Again, a localised indurated swelling in the breast may be a scirrhus, an adeno-fibroma, or a chronic abscess. Apart from other considerations, the greater the induration the stronger is the probability of its being malignant. The author's experience, however, leads him to the conclusion that too great a value is given to this sign in the diagnosis of mammary tumours.

Treatment.—Very little can be done for non-inflammatory induration, and the more chronic the latter the less is the chance of success. The indications for treatment are—(1) to remove the cause; (2) to administer absorbents, such as mercury and iodide of potassium; (3) to apply well-directed continuous pressure.

In the limbs a Martin's bandage will do good service. For enlarged indurated glands in the neck the patient should be directed to lie down for a few hours each day, with a bag containing from two to six ounces of shot placed over the swelling.

Augustus J. Pepper.

INFARCT. *See* Embolism.

INFLAMMATION.—The process of inflammation may be defined as the succession of changes which occur in a living tissue when it is injured, provided that the injury is not so severe as at once to destroy its structure and vitality; the extent of these changes depending on the length of time and the energy with which the cause acts. For experimental purposes inflammation is usually induced by the application of an irritant; and if we look at a part under the microscope in which inflammation has been set up in this way, two sets of phenomena are witnessed—the earlier, which appear to have their seat in the blood-vessels, and the later, in which changes in the tissue are most marked.

In looking at the early phenomena of inflammation we have to remark two things—viz. disorder of the circulation and transudation of certain of the contents of the blood-vessels. Before proceeding to consider these, it will be well to recall some of the facts with regard to the normal circulation, especially as witnessed in the web of the frog's foot. On looking at the normal circulation in the frog's web, one sees the arteries, veins, and capillaries, the arteries being considerably smaller than the accompanying veins, and constantly varying in calibre, not synchronously with the heart's action but independently of it. The blood is also seen to be circulating with great rapidity, the corpuscles passing with ease through the capillaries, and showing no tendency to accumulation or adhesion either to one another or to the walls of the vessels. Further, the flow is apparently a steady one, and it is impossible to tell from observation of the circulation when the systole of the heart occurs. In the frog's foot one also sees the pigment-cells in the skin and around the vessels. The pigment consists of minute granules, suspended in the protoplasm of the cells, and the cells are large bodies with numerous branches which anastomose freely with each other. It is by means of these pigment-cells that the frog changes its colour. When the frog becomes dark, the pigment leaves the body of the cell, and becomes diffused throughout the branches. When the frog becomes light, or when it dies, the pigment-granules collect in a dense mass in the centre of the cell. Between these two extremes there are all sorts of gradations. The extreme change is a reflex occurrence, the optic nerve being the afferent one, and variations in the distribution of the pigment are constantly occurring in health.

If the mesentery of a frog is spread out and placed under the microscope, the early phenomena of inflammation may be observed in it as the result of the exposure to the air. The first change seen is a dilatation of the arteries, which begins immediately and is progressive, the diameter of the artery often ultimately exceeding that of the vein; the normal variations in calibre also cease. In some instances, after application of an irritant to a frog's web, a preliminary contraction is observed; but this seems to depend on the nature of the irritant employed, alkalies, tartar emetic, and corrosive sublimate being those especially followed by this preliminary contraction. By-and-by the veins also dilate. At the same time, the rapidity of the movement of the blood increases in the first instance. This is, of course, the converse of a mere physical effect, for, supposing the capillary resistance to remain the same, dilatation of the vessels would be accompanied by decrease instead of increase of rapidity. This acceleration only lasts a short time, however, for the rapidity of the circulation soon becomes slower than normal, the individual corpuscles being readily recognised. This slowing is seen to be due to the fact that the corpuscles now find difficulty in passing through the vessels, more especially through the capillaries, from the tendency they have acquired for adhering to one another and to the walls of the vessels. This leads to heaping up of the corpuscles in the capillaries. The effect of the systole of the heart can be seen, and very soon complete stagnation occurs. This is termed inflammatory *stasis*. This stasis only occurs in the part on which the irritant has acted most intensely; in its immediate neighbourhood the circulation is going on with difficulty, while around the inflammatory area there is dilatation of the vessels and increased rapidity of flow.

These phenomena have been, at various times, attributed to the dilatation of the vessels, to changes in the blood, or to changes in the tissues. Dilatation of vessels alone will not give rise to stasis, as can be seen by division of the sympathetic nerve in the neck leading to dilatation of the vessels of the ear, but to none of the other phenomena of inflammation. The dilatation is, in the first instance, a purely functional phenomenon developed through the nervous system, and often affects a wider area than the inflamed part, as seen in the inflammatory blush. As regards the second point, there is no change in the blood, and no increased adhesiveness of the corpuscles drawn from the inflamed area over those taken from other parts of the circulation. Further, if the margin of the area of stasis is watched, it will be seen that, as the corpuscles pass out of the inflamed area, their tendency to adhere ceases, and they pass on in the healthy blood-vessels as readily as do the other corpuscles. It will also be observed that the corpuscles of fresh portions of blood, as they pass into the inflamed area, acquire this same tendency to adhere, a tendency which they lose again on passing into the healthy vessels. Further, as only one small portion of the blood was acted on by the irritant used, the blood which is present in the area of stasis cannot be that which was acted on by the irritant. That the irritant itself does not necessarily affect the blood is shown by the fact that, if chloroform is applied to the web, inflammation and stasis result, whereas chloroform added to blood prevents the adhesion of the blood-corpuscles. And also, after pinching a part, inflammatory stasis follows, although there can be no action on the blood.

We must therefore conclude that the cause of the slowing of the current and of the ultimate stasis is some alteration which the tissues have undergone, and that the corpuscles, when they pass into the injured area, there acquire the tendency to adhere. Experiments, carried on by Sir Joseph Lister, have shown that the walls of healthy vessels differ from ordinary solids in having no tendency to permit coagulation; but when the walls become unhealthy this power is lost, and there is a tendency to coagulation when the blood comes in contact with them, just as when it touches any ordinary solid. In further explanation of these phenomena, the study of the pigment-cells shows that this state of the walls of the vessels is a condition closely allied to death of the part, but recoverable—a suspension of the functions of the tissue. When death of the pigment-cells occurs, the pigment becomes completely concentrated; this is the constant post-mortem change. When, however, an irritant is applied of sufficient strength to cause inflammation, the pigment instantly ceases to move, and remains in the state in which it was when the irritant was applied, although the frog may afterwards change its colour elsewhere.

We now come to the second series of changes which occur in the early stages of inflammation—viz. the exudation of liquor sanguinis and corpuscles. It has been demonstrated that white corpuscles can move by shooting-out processes, in the same way as amœbæ do, and they also resemble amœbæ in taking up granules into their interior. This double property may be demonstrated by a very simple experiment. Introduce finely-divided cinnabar into the dorsal lymph-sac of a frog, and then put in the dead cornea of some animal. If the cornea is removed in a few days, it will be found that it has become infiltrated with leucocytes containing granules of cinnabar, thus proving that the leucocytes have come from the lymph-sac, and must have got into the cornea by some method of locomotion.

If the centre of a cornea is cauterised with nitrate of silver, the whole cornea will in a few days become more or less opaque, and this opacity will be found on examination to be due to the presence of numbers of leucocytes. If, however, the eye be examined one or two days after the cauterisation, the opacity—i.e. the leucocytes—will be seen in the form of a ring round the margin of the cornea, this ring later on spreading to the centre. If cinnabar was introduced into the lymph-sac before the cornea was cauterised, it will be found that a certain small proportion of the corpuscles in the cornea contain particles of cinnabar. If the cinnabar was injected into the blood-stream instead of into the lymph-sac, the number of corpuscles containing particles will be found to be much greater. Hence, it is clear that part at least of the leucocytes found in the cornea came from the lymph-sac or from the blood-vessels, and as every white blood-corpuscle would not take up the cinnabar, it is probable that the number of corpuscles which have come from the blood is much greater than the number of those which contain cinnabar.

How did these corpuscles get from the blood-vessels into the cornea? They passed out through the walls of the capillaries and smaller veins. This process has been seen to take place in the mesentery of the frog. If the mesentery is spread out on a glass plate, inflammation occurs as the mere result of the exposure to the air, and the whole process may be watched. The dilatation of the arteries and the subsequent slowing of the blood-stream are well seen. If now we observe a small vein, we see the following phenomena. As the circulation becomes slower the individual corpuscles may be recognised, and it will be found that, while the red corpuscles flow more or less in the centre of the current, the white corpuscles roll along the wall of the vessel, often adhering for a time, and then being ultimately detached and swept on, to stick again at another part. By-and-by, as the result of this tendency of the white corpuscles to stick to the wall of the vessel, they begin to collect in numbers, so that the vein becomes lined with a layer of these bodies, which remain almost motionless. If now the outer part of the wall of the vessel be watched, minute, colourless, button-shaped elevations will be seen to spring out, as if they were buds from the wall. These increase gradually till they become hemispherical, and at last a pear-shaped body is seen, the stalk of which is attached to the surface of the vein; gradually this mass of protoplasm becomes completely detached, shoots out processes, and moves on into the tissue. This migration of white corpuscles does not occur in the arteries, but is very rapid in the capillaries, from which red corpuscles have also been seen to escape.

While this is going on, the fluid contents of the blood-vessels also pass out, as the result, apparently, of a leaky condition of the walls of the vessels, and not, as at one time supposed, on account of increased attraction on the part of the tissues. The fluid part soon coagulates in the tissue, or on free surfaces, and this coagulated liquor sanguinis, with entangled leucocytes, forms the lymph which glues the cut surfaces of wounds together, and which is seen on the surface of serous membranes.

Up to this time the original structure of the tissue is still apparent; but if the process goes on longer, changes occur which result in the disappearance of the structure of the part and its replacement by a new tissue, which is called *granulation-tissue.* This name is given to the tissue because its structure is of the same elementary character as that of the granulations seen on the surface of wounds, consisting simply of a mass of roundish cells adhering to each other (i.e. embedded in an apparently homogeneous matrix) and of elementary blood-vessels. It does not matter what the tissue is, or how complex the structure of the organ in which the inflammation occurs; provided the disease has lasted long enough, the special structure of that tissue or organ disappears and its place is taken by granulation tissue. The question now arises, Whence does this new tissue come, and why has the original structure disappeared? As we have already seen, numerous white blood-corpuscles pass out of the blood-vessels during the early stages of inflammation, and some hold that these are the only source of the cells found in granulation-tissue. This view seems, however, exaggerated and difficult to reconcile with various facts, and therefore, while we admit that it is probable that leucocytes or their progeny form part of the cells of granulation tissue, we find that these have other and perhaps more prolific sources.

Irritate cartilage by passing a seton through it, and the following changes will be observed to occur. At a point far removed from the source of irritation, it will be seen that the cartilage-cells become larger and the protoplasm more abundant. The nucleus then divides, both portions remaining still surrounded by the same mass of protoplasm. The protoplasm then divides, and thus we have two cells instead of one, each of which excretes around itself a cartilaginous capsule. Nearer to the injury we find that this division of cells inside the mother capsule has continued, till a large number of young cells have accumulated in it; but these have lost the property of excreting cartilage around them, and they have also become rounder so as to resemble leucocytes. While this multiplication of cells is taking place inside the capsule, its wall is dilating, and the intercapsular cartilaginous substance is disappearing. At length we find that these enlarged capsules have opened into each other and on the surface, where the cells form granulation tissue in which embryonic vessels appear. In this case, as cartilage is devoid of blood-vessels, and as no channels are as yet known by which leucocytes could penetrate into it, we must conclude that the granulation-tissue has been formed from the cartilage-cells. Similar facts have been stated as to other non-vascular tissue, such as the cornea, but there the matter is doubtful. Changes have, however, been observed in the endothelial cells lining the great omentum in adult animals, which seem to point to their hypertrophy and development into round cells.

In vascular tissues, multiplication of the tissue-cells has also been described. In the case of the subcutaneous cellular tissue the connective tissue cells hypertrophy, the fat disappears from the fat-cells, the nucleus divides, and several cells are formed in the original fat-capsule. While these changes are going on in the cells, the fibres of the connective tissue become soaked with fluid, less apparent, and ultimately disappear. The walls of the vessels also undergo changes, the cells constituting them become swollen, their nuclei more apparent, and they soon subdivide, the process ending in the complete disappearance of the old vessels or in the formation of new ones. Similar changes have been described in inflammation of muscle; the fixed corpuscles of the fibre sheaths and the cells of the connective tissue between the bundles of fibres undergoing multiplication, the muscular tissue ultimately disappearing, and being replaced by granulation tissue. That the new cells are formed in this way is often evident from their arrangement in rows corresponding with the position of the muscular bundle.

It thus appears that one, and perhaps the chief, source of the cells which constitute granulation-tissue is from proliferation of the connective-tissue cells of the part; but at the same time it cannot be denied that some are either white blood corpuscles which have passed out of the vessels or are derived from them. The young vessels are probably formed in the same manner as in the embryo.

Results of Inflammation.—1. *Exudation.*—In all inflammations there is exudation, but it varies much in character. As a rule, exudations are fibrinous. The liquor sanguinis escaping from the vessels contains large quantities of fibrinogen, and, meeting with the fibrinoplastic substance and the ferment contained in the tissues, more especially in the cells, it coagulates. At the same time, the white corpuscles also pass out of the vessels, and it is this coagulated liquor sanguinis, with entangled corpuscles, which is known as lymph. In some instances these exudations are of a mucous character, as in joints, and this mucin coagulates on the surface. On serous membranes the lymph, which also contains a little mucin, forms layers on the surface, and this goes by the name of croupous exudation. This croupous exudation also occurs in the lungs in croupous pneumonia, but it is not the same as the false membranes which form in croup, which apparently do not contain fibrin, but consist mainly of epithelial cells soldered together.

2. *Resolution.*—Complete resolution can only occur at an early period in inflammation, before the changes in the tissue have taken place. When resolution occurs, the stasis disappears, the tendency to slowing of the circulation and adhesion of the corpuscles diminishes and finally ceases, the effused and coagulated liquor sanguinis becomes granular, and is removed by the lymphatics, and the white corpuscles which have passed out of the vessels either reenter them, or pass into the lymphatics, or become fatty and break down. Thus the part returns to its condition previous to the inflammation.

3. *Retrogression.*—In this case the tissue changes have gone on to such an extent that there cannot be a restoration of the original structure; there must be new formation. The character of this new formation varies according to the situation of the inflammation, but it almost always belongs to the class of connective tissues, though sometimes special tissues, such as nerve and muscle, may be regenerated to a slight extent. The changes which take place will be more fully considered under the healing of Wounds, but they consist essentially in elongation of the round cells and the formation of connective tissue. The numerous vessels of the granulation-tissue become atrophied as the process goes on, the whole tissue shrinks as it becomes older, and in this way depressed scars form in organs which have been the seat of acute

inflammation, even though suppuration has not taken place. In connective tissue this new tissue resembles connective tissue, in bone it resembles bone, in tendon it resembles tendon; but there is, as has just been said, no reproduction of complex structures.

4. *Suppuration.*—This process is described in detail under SUPPURATION.

5. *Ulceration.* *See* ULCERATION.

6. *Sloughing.* *See* SLOUGH AND SLOUGHING.

So far we have been considering acute inflammation, but there is another variety termed chronic inflammation, in which the changes above described take longer in their development, and differ somewhat in their results. As a consequence of chronic inflammation there is, as in the acute form, destruction of the tissue of the part and its conversion into granulation-tissue, but from the very first retrogressive changes are marked. Thus, in a part the seat of chronic inflammation, there may be very few round granulation cells, the majority having become spindle-shaped, and many of them having formed fibrous tissue. Chronic inflammation may go on without the occurrence of suppuration, or it may lead to suppuration or ulceration. When chronic inflammation continues without suppuration or ulceration, the inflamed part may assume two forms—one in which it becomes much larger than normal, and the other in which it actually becomes smaller. The latter form is probably preceded in its earlier stage by enlargement of the part. In white swelling of the knee-joint we have a good example of enlargement of a part as the result of chronic inflammation. If we examine a specimen of the inflamed synovial membrane, we find that there are numerous granulation cells in places, more especially around the vessels, but that the tendency is for these cells to become elongated and spindle-shaped, and to develop fibrous tissue. This fibrous tissue, however, remains swollen and imperfect, and the individual cells are often widely separated from each other by swollen intercellular substance. At parts the white cells become heaped together, and here abscesses may form. The appearances in this form are further complicated by the presence of tubercles at various parts. In the second variety of chronic inflammation the swelling of the intercellular substance is less marked, and the formation of fibrous tissue is the chief thing that is noticed. The result of this formation of fibrous tissue is that, as it contracts, it presses on the tissue in its vicinity and causes it to atrophy. This is well seen in cirrhosis of the liver. The results of chronic inflammation are retrogression, suppuration, and ulceration.

Varieties of Inflammation.—As we have seen, inflammation is a complex process consisting of congestion, exudation, new formation, suppuration, &c. One of these may be more prominent than the others, giving the inflammation a special character and leading to the formation of distinct varieties of inflammation.

1. Congestion may be most marked, as in the cutaneous erythemata, erysipelas, acute catarrhs, rheumatic inflammation of joints, &c.

2. Exudation may be the main element, as in pneumonia, pleurisy, pericarditis, &c.

3. Some inflammations are essentially suppurative, as those which occur in the course of pyæmia, puerperal fever, &c.

4. New formation may be the chief feature, as in periostitis, cirrhosis, &c.

In tuberculosis and syphilis the inflammations also present special characters.

Etiology of Acute Inflammation.—We have already defined inflammation as 'the succession of changes which occurs in a living tissue when it is injured, provided that the injury is not so severe as at once to destroy its structure and vitality; the extent of these changes depending on the length of time and the energy with which the cause acts.' We may therefore divide the immediate causes of inflammation into groups according to the length of time during which they act. The predisposing causes may be considered afterwards.

1. Some causes only act transiently, and corresponding to this transient action the inflammation soon ceases. In some cases, as possibly in the action of cold, the inflammatory phenomena do not go beyond the early stage, and resolution occurs in a few hours if no serious damage has been done to the part, or if no further cause keeping up the inflammation comes into play. The best example of the action of a transient cause is seen in the healing of a wound by first intention. The knife in its passage through the tissues causes damage, which results in the occurrence of the early stages of inflammation and the exudation of liquor sanguinis and white blood-corpuscles. But the cause having ceased to act and no fresh cause having come into play, the inflammation ceases, organisation of the exudation takes place, and the wound heals.

Whether, apart from any direct damage done to the tissues by mechanical or chemical agencies, disturbance of the nervous system alone can set up and maintain inflammatory action, is a very moot question, although held by some. In any case, it seems improbable that nervous disturbance alone could keep up an acute inflammation and lead to suppuration.

2. Most of the causes act longer and more intensely, and set up a correspondingly severe inflammation. Various chemical substances, such as croton oil, tartar emetic, blistering fluid, &c., act for some time, and even after one application cause pustules or blisters. Why croton oil on the one hand should cause pustules, and blistering fluid on the other hand cause vesication, is as yet quite unexplained. Other chemical substances only cause a slight amount of inflammation at a single application, but, if frequently applied, will even set up suppuration; such are carbolic acid, iodine, &c.

3. In contrast to these various causes are those which, when once introduced, go on acting for a long time, and may produce various results, such as fibrous formation, suppuration, ulceration, gangrene, &c. Of these, certain foreign bodies may, by their mechanical action, keep up a state of inflammation leading to fibrous formation or to suppuration. But the most common causes are self-multiplying agents, the living ferments or micro-organisms. And seeing that almost all acute inflammations are due to some cause which goes on acting for a considerable time, and that in these cases micro-organisms are always present, we must conclude that the great majority of inflammations, and more especially of suppurations, are intimately connected with the growth of these organisms. In all acute abscesses, and in almost all suppurating wounds, micrococci are present, which are without doubt the cause of the suppuration; and they probably cause the inflammation by forming, as the result of their growth, products which irritate the tissues and cause them to inflame. It is in the highest degree probable, that it is the absorption of these same products into the circulation which produces the general febrile disturbance.

The character of the inflammation depends to a great extent on the species of micro-organisms present, for there are several different kinds associated with inflammation. Thus, one variety produces erysipelas, others cause the formation of abscesses, and others again cause phagedæna or spreading gangrene. But though much depends on the kind of organism present, much also depends on the place where it grows. Thus, the *staphylococcus pyogenes aureus*, growing in the cellular tissue will cause an ordinary acute abscess, growing in the glands of the skin will cause a boil or carbuncle, and growing in bone will cause acute osteomyelitis. Here the result is dependent mainly on the anatomical structure of the part. As has just been remarked, there are various micro-organisms associated with inflammation, and even an acute abscess is not always caused by the same species. Some of these will set up the disease at once, without any previous injury of the tissue predisposing to inflammation; others, apparently, act only when present in large numbers, and in a tissue already in the early stages of inflammation. When, for instance, a wound fails to heal by first intention, it is generally due to the entrance of micro-organisms. The tissue is already in a state of inflammation, as the result of the injury done by the knife, but this would soon subside, as the cause has ceased to act; but if micro-organisms, capable of growing in tissues, obtain entrance, they form a further and continuously acting cause of inflammation, and lead to continuance of the process and ultimately to suppuration.

Predisposing causes are causes which depress the vital powers, and may be divided into general and local. Of the general causes we may mention drunkenness, exhaustive diseases, starvation, bad food, ingestion of decomposing matters, &c. Under these conditions the vitality of the tissue is much diminished, repair after injury does not take place so readily as in a state of health, and in this enfeebled state a lower degree of irritation or injury is required to produce inflammation, than is the case under normal conditions. But, in the opinion of the writer, this is not the only mode in which these causes act: they also permit the entrance of the living exciters of inflammation — micro-organisms—into the body. When the body is healthy, no living organisms (except, of course, certain pathogenic ones) can penetrate into the blood, or, if they do reach the blood alive, they soon die. Hence, a collection of blood (hæmorrhage after a blow), or a piece of dead tissue (as in an infarct), may lie in the body without giving rise to acute inflammation—may, in reality, become absorbed and disappear. But where the vital powers are depressed, as by bad food, drunkenness, &c., micro-organisms may enter the circulation, and, not being destroyed at once, may become deposited in the piece of dead tissue or in the collection of blood, and, growing there, set up inflammation. The low state of health thus predisposes to inflammation by permitting the entrance into the circulation of living micro-organisms. This has been experimentally proved in the lower animals, by feeding them on very foul putrid material and then causing subcutaneous hæmorrhages; abscesses containing micro-organisms have resulted. In Chauveau's experiments on *bistournage*, the effect of the presence of micro-organisms in the tissues was demonstrated. In the operation of *bistournage* the testicle is twisted till the cord and vessels are ruptured, the result being that the organ atrophies and disappears. But if, before *bistournage* is performed, a quantity of septic material be injected into the circulation, the testicle on which this operation is performed becomes inflamed, and a septic abscess results. And the writer has observed in the case of a drunkard suffering from albuminuria, and in a low state of health generally, that whenever he received a bruise, an abscess containing micrococci formed at that part.

Certain specific states of the system, as the gouty and rheumatic diatheses, are also often reckoned as predisposing causes, though they hardly come into the same category as the above.

The local predisposing causes are likewise such as lead to imperfect vitality of the part, such as local congestions, say from varicose veins, atheromatous arteries, imperfect innervation, &c.

Symptoms.—The symptoms of inflammation, both local and general, vary with the seat and intensity of the inflammation. Let us take a simple acute inflammation of the subcutaneous cellular tissue as the type. The symptoms are subdivided into local and general.

Local Symptoms.—The cardinal symptoms of inflammation are redness, heat, swelling, and pain. The redness may or may not disappear on pressure. At the marginal part of the inflammatory swelling the redness is of a bright colour, and disappears readily on pressure; it is there due simply to dilatation of the blood-vessels. Towards the centre of the swelling the redness is of a darker colour, and often persists in great part on pressure; there it is due to stasis in the blood-vessels or to extravasation into the tissues, or, it may be, to migration of large numbers of red blood-corpuscles. The swelling is due to the exudation of liquor sanguinis and blood-corpuscles. The pain is caused by pressure of the exudation on the sensory nerves either from the outside, or probably more generally by exudation into the sheath of the nerve itself. The heat is partly due to the increased flow of warm blood through the part, raising the temperature of an external part to that of the blood in the internal organs. Apparently, however, according to the researches of Mr. Simon, there is also a local production of heat in the inflamed part, the temperature of the venous blood leaving an inflamed part being higher than that of the arterial blood entering it.

Constitutional Symptoms.—Along with these local effects there is more or less disturbance of the general condition of the patient, varying in character chiefly according to the intensity and cause of the inflammation. The first symptom of inflammatory fever is generally a feeling of chilliness, followed by heat; the patient may even have a shivering fit. The temperature rises, the height varying with the intensity of the inflammation; it generally reaches 102° to 103° in from twenty-four to forty-eight hours, remains at that height for about twenty-four hours, and then, in the case of an open wound, as suppuration occurs, it rapidly falls till, on the fourth or fifth day, it is again normal. The pulse becomes quick, hard, and wiry; the tongue becomes dry and furred. The secretions are diminished or arrested; the skin hot and dry; the urine scanty and high-coloured; the bowels constipated. There is also headache, and, where the symptoms are severe, there may be delirium. The other symptoms disappear, along with the fall of temperature, when suppuration takes place in the case of an open wound, provided that no complication has occurred.

As has been previously remarked, the local and constitutional symptoms of inflammation vary according to the seat, intensity, and cause of the inflammation. The details of these symptoms will be found under the proper headings; it will be sufficient here to illustrate what is meant. In acute suppurative periostitis or osteomyelitis the pain is intense, but—especially if the bone be deep-seated, as the femur—swelling is little, if at all, noticeable. At the same time, the constitutional symptoms, which at first were those of inflammatory fever, soon undergo a change and resemble those of septicæmia; in fact, the patient suffers from septic poisoning due to absorption of septic products from the inflamed bone. Another example of the influence of the site of the inflammation on the symptoms is seen in whitlow, where the local symptoms and constitutional disturbance are out of all proportion to the extent of the affection. The cause of the inflammation also determines the severity of the symptoms. The passing inflammation which follows a cut or an injury is so slight, that it is not recognised as inflammation at all by many writers; while, in the infective inflammations, the symptoms are characteristic and generally severe.

When the inflammation is chronic, the symptoms are much less marked. There is generally no increased redness over the part, and the vascularity of the part itself is not nearly so great as in the acute. There is but little pain or tenderness, and even where in some situations, as in the periosteum, pain and tenderness are present, they are not as a rule severe. There is no increased heat of the part. As regards the constitutional symptoms, these depend on the same cause as the chronic inflammation rather than on the inflammatory process itself.

TREATMENT OF ACUTE INFLAMMATION.—In considering the treatment of acute inflammation, we must first speak of acute inflammation in connection with a wound or injury, and secondly of acute inflammation occurring without any evident wound. And the reason for this separation is the fact that, in the first class of cases, much may be done by preventive measures; while, in the second class, the cause has generally begun to act before we know that it is there, and, therefore, we can only use curative measures.

Preventive Measures. — The various local causes of inflammation in wounds may be summed up in the one word—unrest; and the causes of unrest are mechanical or chemical. The mechanical causes of unrest are movements of the part, either of a limb as a whole or of individual muscles, also pressure as from a pad in the wrong place, pressure of a splint, &c.; further, such causes as the weight of flaps, placing the limb in an extended position when a flexed position would allow the edges of the wound to lie easily together or *vice versâ*, allowing a limb to hang, thus impeding the circulation, tight stitches, &c. The chemical causes of inflammation are irritating chemical substances, but, more especially, decomposition in the discharges of the wound, from the growth of micro-organisms in them or in the tissues of the wound itself. These local causes being understood, it is quite plain how they must be remedied. Rest must be secured in one way or another. Mechanical rest will be secured by keeping the part still, in the case of an extremity by the application of a splint, by keeping the extremity elevated, by seeing that the position is such as to separate the parts as little as possible, and by avoiding pressure, tight stitches, &c. Chemical rest is obtained by avoiding the application of irritating chemical substances to the wound, but more especially by taking measures to exclude micro-organisms. In cases where aseptic treatment cannot be thoroughly carried out, means must be taken to hinder the development of micro-organisms, as much as possible, in some of the ways described in the article on ANTISEPTIC SURGERY, by free drainage, avoidance of tension, antiseptic irrigation, &c. The unrest produced by decomposition and growth of micro-organisms being much more serious than that caused by the application of antiseptics, the latter—the lesser of the two evils—must be chosen.

At the same time any general condition which predisposes to inflammation must be remedied as far as possible. Good food must be given (it is quite a mistake to keep a patient on low diet with the view of preventing inflammation); if necessary, stimulants, and tonics such as iron and quinine, while any constitutional peculiarity, such as gout, syphilis, &c., must be treated by specific remedies.

With regard to preventive treatment, it must be borne in mind that inflammation of glands may occur from absorption of poisonous (phlogogenic) materials from wounds. This can be avoided by preventing the development of these materials in the wound, as by antiseptic treatment.

The *curative* treatment of inflammation in wounds will be found under WOUNDS.

We next pass on to inflammation occurring without evident connection with an external wound, such as acute abscess. Here, as has been previously remarked, the inflammation has already begun before we see the case, and, therefore, preventive treatment does not come into play; though, if the inflammation be dependent on some constitutional state, attempts may be made to remedy that with the view of preventing future attacks.

1. Here, as in the preventive treatment, rest is a most important element. The inflamed part should be kept still; if an extremity, it should be laid on a splint and elevated. Special apparatus is required for special cases, and these will be found described under the proper headings. Thus, for an inflamed joint it is not only necessary to secure rest by means of splints or sandbags, &c., but the tendency to spasmodic contractions of the muscles

must be counteracted by a suitable extension apparatus.

2. The second point which is aimed at, in the treatment of acute inflammation, is to diminish the vascular excitement. This is attempted in three ways.

a. By the application of cold with the view of causing contraction of the arteries. That cold does act in this way even on deep-seated parts there can be no doubt; it is constantly evidenced by the effect of cold in checking hæmorrhage. Not that the cold need penetrate to the seat of inflammation; its effects are produced by reflex action. The necessary cold may be obtained by the application of ice or cold water or evaporating lotions. The ice is conveniently enclosed in a thin india-rubber bag, so that the skin remains quite dry. Ice-cold water is conducted through a coil of metal tubes (Leiter's tubes), which can be laid over the part or made to surround it. By means of a continuous flow of iced water through Leiter's tubes a constant low temperature is maintained, and this is in reality the most satisfactory method of applying cold. It is dangerous to apply ice or cold water directly to the skin, for it has been found that there is a great risk of frostbite and gangrene if this is done. On the other hand, with dry cold this danger is not nearly so great, though, at the same time, this method of treatment must always be employed with caution. As a rule, it is only useful in the early period of the inflammation, and when its application ceases to give the patient relief, it is time to discontinue it. By the use of evaporating lotions a certain amount of cold may be produced. Of these the most commonly employed are spirit and lead lotion or hydrochlorate of ammonia and spirit (Ammon. chlor. ℥ss., Spirit. rect. f℥j., Acidi acet. dil. f℥jss., Aq. ad f℥viij.). Whatever means of producing cold is employed, it must be continuously applied; intermittent applications only do harm.

b. By local or general depletion, by which a similar contraction of the arteries is brought about. Local depletion is carried out by means of leeches, cupping, or scarification. Great relief, and at least temporary improvement, is generally experienced as the result of this treatment. More effectual than these methods are free incisions, but this will be referred to again. General blood-letting hardly comes into consideration in the treatment of surgical inflammations.

With the view of diminishing the flow of blood to an inflamed part, it has also been suggested, and in some cases successfully practised, to compress or ligature the main artery leading to the part. This has been chiefly employed in inflammations of joints or bones, more especially after gunshot injuries.

c. By the use of the so-called antiphlogistic remedies. Of these the most generally recommended are antimony and aconite, more especially the former. Antimony is first given in sufficient doses to produce vomiting, and then is continued in small doses. For the same purpose laxative and purgative remedies are also used. These to a certain extent act like blood-letting by withdrawing fluid from the body, but probably their chief action is by the removal of waste products and by counter-irritation.

Where the inflammation is extensive and the febrile symptoms are of the acute sthenic type, the diet ought to be restricted; as a matter of fact, the patient has lost all appetite, and thus restricts his diet himself. Where the fever is of the asthenic type, depletion and antiphlogistic remedies are contraindicated, the diet ought to be of the most nourishing and easily assimilated kind, and tonics, quinine, and iron should be given. In addition to antiphlogistic remedies, benefit will often be obtained by the administration of sedatives, more especially of opium.

3. A third indication is to get rid of foreign bodies and to relieve tension. The greatest benefit is derived, in acute inflammations, from free incisions through the inflamed parts, even though suppuration has not yet occurred. Of course, these incisions must be made with all aseptic precautions, so as to prevent the entrance of fresh causes of inflammation. If this is done the process will very often cease, and there is no more striking instance of the benefit to be derived from free antiseptic incisions in the early stages of acute inflammation, than the results obtained in cases of acute periostitis or acute necrosis. The disease often ceases at once, and no dead bone comes away. Free incisions act to some extent by depleting the part, but chiefly by relieving tension, for tension is one of the chief causes which assist in keeping up inflammation in a part.

4. Counter-irritation, though more especially useful in chronic inflammation, is also very valuable in the acute disease. There, however, the more severe forms are but seldom employed. In deep-seated inflammations, as in acute meningitis, blisters may be used with advantage. In other

cases, as, for example, in the early stage of glandular inflammations, iodine is useful. But the most common form of counter-irritant employed, in acute inflammation, is the poultice or warm fomentation. How counter-irritants act in arresting inflammation is still purely hypothetical, but the most feasible view is that it is through the agency of the nervous system. Gonorrhœa ceases or diminishes during the occurrence of acute epididymitis; in mumps the parotid gland recovers as soon as the ovaries or testes become inflamed, &c. So, apart from the relief afforded by the warm and moist application, the use of a poultice often diminishes the inflammation deeper down, by reflex action. On the other hand, when once suppuration has begun, it seems to favour the further development of pus and the rapid 'ripening' of the abscess.

5. Certain acute inflammations are readily subdued by the use of specific remedies. Thus, gout is rapidly and favourably affected by colchicum, rheumatism by salicylate of soda, and syphilis by mercury or iodide of potassium.

Treatment of Chronic Inflammation.—Here, again, rest and a suitable position are essentials in the treatment, and the same principles have to be followed as in the treatment of acute inflammation. At the same time much good can be done by more active measures, such as counter-irritation, pressure, and various internal remedies.

The counter-irritants employed are of a more severe nature than in acute inflammation. The best are the actual cautery and blisters. The actual cautery is especially useful in deep-seated chronic inflammations, especially of joints, and in this case it must be thoroughly applied. Better than the button cautery, is the application of the cautery iron over a considerable extent of the skin, in the neighbourhood of the inflamed part. All that is desired is to destroy the surface of the skin, and not the whole of the true skin, and for this purpose the cautery should be at a white heat and rapidly drawn over the surface two or three times. For a few days poultices are applied, till the sloughs separate, and then the sore is dressed with savin ointment and kept open for about six weeks. If it tends to close sooner, in spite of the savin ointment, the healing edge can easily be destroyed by nitrate of silver or by potassa fusa. Issues may also be produced in the first instance by potassa fusa or by chloride of zinc paste, or, in some cases, setons are used. Repeated blistering is also of great benefit in chronic inflammations, and iodine is a favourite application with some, especially for enlarged glands.

Pressure is an excellent remedy in many chronic inflammations, and may be carried out by means of elastic bandages, cotton-wool firmly bandaged on, &c. *See* PRESSURE. In addition to pressure, massage of the part, more especially of a diseased joint (synovial disease), has been strongly recommended. The part is well shampooed once or twice a day for a quarter to half an hour, the pressure being especially applied in the direction of the trunk, with the supposed view of aiding the lymphatic circulation. On the principle of relief of tension, free antiseptic incisions have also been made in chronically inflamed tissues, such as diseased synovial membrane, with excellent results.

In chronic inflammations much benefit may also be derived from suitable constitutional treatment. Nourishing diet, and stimulants if necessary, are administered, along with cod-liver oil, iron, and other tonics, passive exercise in the open air, &c. Of course, in specific inflammations, the suitable specific remedies are invaluable, such as iodide of potassium in syphilis, &c.

W. WATSON CHEYNE.

INGROWING TOENAIL.—This apparently slight affection may become an extremely painful and crippling one. It is met with chiefly in adolescents, more often males, and is due to the pressure of the nail of the great toe into the soft parts, either from the wearing of ill-made boots, with pointed crowding toes, or from the rounding off the angles of the nail instead of cutting them square, and thus allowing the soft parts to encroach beyond their proper limit. The affection may be met with on either side of the nail. The first stage is tenderness, followed by ulceration. When this has lasted any time, a little mass of prominent and very tender granulations is met with at the affected spot, accompanied by unhealthy, foul discharge.

Treatment.—In the earlier stages, a few days' rest, with the foot in the elevated position, the use of lead lotion, allowing the nail to grow square, and, above all, the use of well-made boots, with straight inside borders and room for the toes, will be sufficient. But, later on, when ulceration is present, it is imperative that the pressure of the nail on the soft parts be removed. This may be effected by the following means:—The edge of the nail being raised by a flat, narrow, spoon-shaped spatula, or even by a piece of wood of appropriate size and shape, shreds of lint pressed out of carbolic oil (1–30), or dusted with iodoform, are to be carefully packed with a probe between the nail and the soft parts, so as to press back the latter and elevate the buried nail. The quantity of shredded lint should be gradually increased every second or third day, till the nail is thoroughly raised from its bed in the soft parts. A better plan than the above, in that it requires fewer applications, is the introduction of a small, narrow piece of sheet lead under the edge of the nail. The nail being raised, as directed above, a narrow slip of metal, about two inches long, and slightly overlapping the nail, is introduced well beneath the ingrowing border, and then gently bent over and firmly pressed into position on the upper surface of the nail. Then, any superfluous metal being cut away, the strip is retained in position by narrow strapping and the use of a covering, like the finger of a glove, which is secured round the ankle by tapes. As attempts at introducing anything under the nail are often rendered futile by the pain they cause, it is best to give ether on the first occasion. Professor Humphry, from whom the writer learnt the above method, recommends silver rolled thin enough to bend easily. This raises the nail more efficiently than lead, but is more difficult to obtain. The administration of ether will also enable the surgeon to destroy thoroughly the prominent, painful, and fetid granulations which accompany this affection, by means of undiluted carbolic acid, acid mercury nitrate, silver nitrate, &c. Where the granulations resist the above, and the soft parts overhang the embedded nail, it will be found best, ether being given, to remove by one stroke of a sharp-pointed bistoury the soft parts at the side affected, including the above granulations. This step leaves a healthy sore, which, contracting quickly as it heals, leaves nothing for the nail to press upon.

The surgeon, failing with lint, or not being able to provide himself with metal, may place a bit of sponge-tent, wrung out of carbolic oil, or well powdered with iodoform, under the nail. The point of chief importance is to well elevate the nail on one or two occasions, by means of the above-mentioned spatula. When once this has been thoroughly effected, the pressure of the body well introduced, especially if this be metal, causes atrophy of the ingrowing granulations and soft parts beneath.

Where the patient refuses any operative interference, the granulations and soft parts over the nail must be drawn away by strapping, while iodoform, pulv. æruginis, powdered lead nitrate, lotions of copper or iron sulphate (gr. iv.–f℥j.), are perseveringly applied, and the centre of the nail rubbed down from matrix to edge with glass or a blunt knife, to cause its shrinking.

Removal of the nail is only to be employed in a limited number of cases, for it must always be remembered that, while the new nail may, with proper attention, grow straight and healthy, it may, on the other hand, assume a faulty direction, and appear, in addition, uneven and distorted, owing to injury inflicted on the matrix at the time of the evulsion, aided by preceding inflammation. Where the patient finds the introduction of the lint or metal unbearable, where in advanced cases previous treatment has failed, or where the nail is loosened or much diseased, evulsion is to be practised. The patient being under the influence of nitrous oxide or ether, one blade of a broad-bladed, stout dressing-forceps is driven down close to the nail as far as its root; the blades are then closed, and the nail, loosened by one or two lateral twists, is withdrawn by a direct pull. If it be desired to remove one half of the nail only, this should be first divided by the introduction of sharp-pointed scissors. In removing the nail, sufficient care is not usually taken to inflict as little injury as possible on the subjacent matrix. After removal the surface left should be dressed with iced lead lotion, carbolic oil (1 in 40), iodoform or powdered lead nitrate, and the patient should lie up on a sofa for a day or so, then going about with an easy shoe. *See* Nails, Diseases of the.

W. H. A. Jacobson.

INGUINAL HERNIA. — Inguinal ruptures may be divided into two great classes: 1. The external, oblique, or indirect. 2. The internal, or direct.

1. The External or Oblique Hernia. In this form the rupture occupies, in whole or in part, the inguinal canal. This canal runs obliquely from the internal to the external abdominal ring, and is about 1½ inches in length. The external ring is readily felt, in the male, by invaginating the scrotum with the point of the finger, and then passing the digit up in front of the cord. If the nail be kept against the cord, the pulp of the finger can readily recognise the triangular, slit-like opening. In normal conditions in adults it will just admit the tip of the little finger. In females the ring is somewhat less easily felt, owing to the

slighter laxity of the tissues of the labium pudendi. The internal ring is situate about half an inch above the middle of Poupart's ligament. The neck of the sac is at the internal ring, and just to the outer side of the deep epigastric artery. The hernial tumour, as it occupies the canal, lies in front of the structures forming the spermatic cord. The protrusion may appear merely as a bulging at the internal ring. It may occupy the inguinal canal, but not project beyond the external ring, in which case it is called a bubonocele. It may project beyond the outer ring, and may occupy the scrotum or labium (scrotal or labial hernia).

In external inguinal hernia the sac may be either acquired, or it may exist ready-formed, owing to certain congenital defects in the processus vaginalis.

The acquired hernia in this position is comparatively rare before adult life, and is much more common in men than in women. It forms slowly, but in time it may attain very considerable dimensions. In old acquired, herniæ not only do both the abdominal rings become much enlarged, but they are also approximated, so that a time comes when the internal ring is almost directly behind the external ring, and the inguinal canal has practically no existence. When such herniæ are reduced, they appear to go directly back into the abdominal cavity.

The oblique hernia, depending upon congenital defects in the processus vaginalis.—The descent of the testicle in the fœtus is preceded by the passage into the scrotum of a process of the peritoneum—the vaginal process. The testicle usually enters the internal ring abouth the seventh month of fœtal life, and by the eighth month is in the scrotum. The vaginal process is often found open at birth, and even for two, three, or four weeks after birth; but it is more usually found cut off from the peritoneal cavity, the portion thus isolated forming the tunica vaginalis. The manner in which it is cut off is as follows:—It becomes obliterated in two places, at the internal ring, and at a spot just above the epididymis, the obliteration usually beginning at the higher point first, and proceeding downwards. Supposing obliteration to have taken place at these two points, the vaginal process between them will be represented by an isolated tube. This soon shrinks, closes, and dwindles to an insignificant fibrous cord. It may, however, remain patent in part, and, if fluid accumulates in this patent portion, an encysted hydrocele of the cord is produced.

As regards the mode of closure three contingencies may happen, each giving rise to a particular form of hernia: (1) The process may not close at all. (2) It may close at the upper point only. (3) It may close at the lower point only.

(1) When the vaginal process is entirely open, gut can readily descend at once into the scrotum. Such a condition is called a *Congenital Hernia.* This form of rupture may be met with at birth, or may appear for the first time some months, or even years, after birth. When a rupture, having all the characters of a congenital hernia, appears for the first time many years after birth—say at the age of seventeen or twenty—the condition of parts is probably that found in cases where an infantile hernia may exist. The congenital hernia appears suddenly, and may pass at once into the scrotum.

(2) When the process is closed only at the internal ring, there is merely a thin septum between the peritoneal cavity and the cavity of the tunica vaginalis. The gut pressing upon this septum may push it before it, or come down behind it. In either case, three layers of peritoneum would have to be cut through before the gut could be reached. This is the *Infantile Hernia* of Hey, or the *Encysted* of Sir Astley Cooper. This hernia is not congenital, but is most commonly met with in infants and young children. It has been seen, however, for the first time in patients of seventeen, thirty, and thirty-five years of age.

There are no special features by which the rupture can be certainly diagnosed before the parts are exposed in herniotomy. It has the ordinary aspect and relations of an oblique inguinal hernia. It forms more gradually than does the congenital rupture, and seldom attains the same dimensions. An oblique inguinal rupture, of slow formation, in a patient under the age of puberty will probably be of this type. The condition of parts that favours the development of this rupture serves also to explain those anomalous cases of congenital hernia which appear suddenly, and for the first time, in adult life. Here, under some unwonted exertion, the septum above described gives way, and the gut at once passes into the cavity beyond, and so appears in the condition of a congenital hernia.

(3) In the last of the three above-named contingencies, a tubular process of peritoneum leads down as far as the top of the testicle, and there ends, the normal tunica vaginalis being beyond. Hernia into this

process is called a *Hernia into the funicular process.*

In the first of these three forms the testicle is quite enveloped in the hernia. In the second and third forms, as well as in the acquired form, it is distinct from the rupture, being behind and below it.

It is important to distinguish between the congenital and the acquired forms of inguinal hernia. In the congenital variety the rupture appears very early in life, and usually develops suddenly, whereas the acquired form is rare before puberty, and is of gradual development. In the former, the relations of the two abdominal rings remain unchanged, and the testicle is enveloped in the tumour. In the latter, the abdominal rings tend to become approximated, the testicle is distinct, and is to be felt behind and below the swelling. The congenital hernia is globular; the acquired, pyriform. The congenital hernia is much more liable to strangulation, and, when strangulated, is much more difficult to reduce by taxis.

The inguinal canal in the female is much smaller and narrower, although a little longer, than it is in the male. It offers such slight inducement to the formation of a rupture, that acquired inguinal hernia is quite rare among females. In the female fœtus a process of peritoneum descends for a little way along the round ligament, and is known as the canal of Nuck. If this process remain patent, as it not unfrequently does, it may lead to a rupture that corresponds to the congenital hernia of males. Indeed, in quite early life, the inguinal rupture is about the only form met with in female children, with the exception of umbilical hernia. In all such instances of early inguinal hernia, the gut has travelled down a patent canal of Nuck.

2. Internal or Direct Hernia.—In this form, the hernia leaves the abdomen through the space known as Hesselbach's triangle, and to the inner side of the deep epigastric artery. There may be two forms of direct hernia. In one form the gut escapes through the so-called middle fossa —a depression in the peritoneum between the epigastric artery and the obliterated hypogastric vessel; in the other, through the inner fossa between the hypogastric artery and the outer edge of the rectus muscle. The middle fossa is nearly opposite to the summit of the external ring. A hernia, escaping through that fossa, would enter the inguinal canal some little way below the point of entrance of an oblique hernia, and would have the same coverings as that hernia, with the exception of the infundibuliform fascia. The inner fossa corresponds with the external ring. A rupture escaping through this fossa is resisted by the conjoined tendon and the triangular aponeurosis. These structures are either stretched over the hernia so as to form one of its coverings, or the conjoined tendon is perforated by the hernia, or, lastly, the gut deviates a little in an outward direction so as to avoid the tendon and appear at its outer side. In any case, the hernia is forced almost directly into the external abdominal ring.

In distinguishing a direct from an indirect inguinal hernia, it must be first noted that the direct hernia is never congenital. In the oblique form the cord is behind the tumour, in the direct it is behind and external to it. In the congenital oblique hernia, and in recent examples of the acquired form, the rupture takes the direction of the inguinal canal, while the direct hernia has its axis almost, if not quite, parallel with the middle line. As has been already pointed out, old oblique herniæ lose a good deal of their obliquity, and, in time, present an axis which is not very divergent from that of the direct hernia. After the reduction of a direct rupture, the edge of the rectus muscle may be readily felt to the inner side of the aperture, and the pulsation of the epigastric artery may be detected on its outer side—features that are both lacking in the oblique variety. Finally, the direct hernia is usually much smaller than the oblique, and assumes a more globular outline.

Speaking generally, it may be said that inguinal herniæ, as a rule, contain small intestine, and often some omentum. In rare cases the rupture has contained the cæcum, the sigmoid flexure, an ovary, and the bladder. In cæcal ruptures there may be no sac, or only a partial one. When the bladder occupies the tumour, there is no sac.

Inguinal hernia is ten times more common in males than in females. It occurs with greatest frequency during the first ten years of life; it then diminishes in frequency, and rises again to attain the second maximum between the ages of twenty and forty. After forty it once more diminishes in frequency.

Inguinal herniæ have been mistaken for hydrocele, hæmatocele, varicocele, and other scrotal tumours; for tumours of the cord, for glandular enlargements in the inguinal canal, for suppurative collections in the canal, for retained testis. For the differential diagnosis of these affections the reader is referred to the article GROIN.

In applying *taxis*, the thigh should be flexed and a little adducted. In congenital herniæ, and in recent acquired herniæ of the oblique variety, the pressure should be in the direction of the inguinal canal. In direct ruptures, and in old oblique herniæ that are not congenital, the pressure should be applied almost directly backwards.

In performing *herniotomy*, the external incision should be about 1½ or 2 inches in length, should be made along the middle of the tumour, and in its long axis, and should be so arranged that its centre shall correspond to the external ring. The superficial external pudic vessels are usually divided in the operation. It is impossible to distinguish the various layers of tissue that cover the hernia, the only one, as a rule, that is recognisable, being the cremasteric fascia. In dividing the constriction, it is recommended to cut upwards in all forms of inguinal hernia. The only vessel in risk of damage is the deep epigastric. In the oblique rupture, an incision directly upwards would quite avoid this artery; but in a direct hernia, where there is reason to suppose that the vessel is in close connection with the neck of the sac, it is well that the incision be directed a little inwards as well as upwards.

FREDERICK TREVES.

INHALATION. *See* ANÆSTHETICS.

INNOMINATE ANEURISM, uncomplicated by dilatation of the arch of the aorta, is of rare occurrence, and the difficulty of distinguishing it from purely aortic aneurism is confessedly great.

Symptoms.—The presence of a pulsating swelling in the region of the right sterno-clavicular articulation, which may be bulged forward or actually invaded by the tumour in its progress to the episternal notch, points to either an innominate or an aortic aneurism, or a combination of the two diseases. Deficient resonance is to be found over the upper third of the sternum, the inner half of the clavicle, and probably over the infra-clavicular region. A *bruit* may, or more probably may not, be present in the tumour, but the heart's sounds are apt to be propagated very clearly into the tumour, and, according to Barwell, while both sounds are heard as plainly as over the cardiac region, it is the second sound which is more especially exaggerated, being often louder than the first. Congestion of the veins of the right side is an early and marked symptom, and, later on, congestion of the left side may follow compression of the left innominate vein by the tumour. The diminution of pulse in both the right arm and neck is an important symptom of innominate aneurism, though not conclusive, since disease of the aorta at the origin of the innominate may give rise to the same symptoms. Dyspnœa and inability to assume the recumbent position are common in cases of innominate aneurism, and dysphagia is not an infrequent symptom.

Treatment.—The treatment of an innominate aneurism by rest and diet is singularly unsatisfactory, the disease making progress so soon as the patient resumes his ordinary habits, and ending before long in death by rupture, or by fatal pressure on the trachea.

The surgical treatment resolves itself into some form of distal ligature, for there can never be room to apply a ligature on the proximal side of the disease. Ligature of the common carotid, of the third part of the subclavian, and of both arteries consecutively or simultaneously, have all been tried, with varied results. According to Erichsen, of the cases in which one vessel alone was tied, in sixteen fatal results were accelerated, in three the progress of the disease was not materially interfered with, in two it was arrested, and in one the result was uncertain, and in one case only was the disease cured. Simultaneous deligation of the two main trunks, on the other hand, seems to have produced a cure in two cases of Barwell's, and one of King's, and to have given great relief in several other instances, both of innominate aneurism and of aneurism which proved eventually to be mainly aortic. Whatever may be the correct theory of the action of the distal ligature (*see* ANEURISM), there can be no doubt that the double distal ligature does produce a marked effect upon aneurisms presumably innominate, and that this is the best operative method to be pursued.

CHRISTOPHER HEATH.

INNOMINATE ARTERY, The, commences at the highest point of the aortic arch, opposite the middle of the manubrium sterni, and ends opposite the upper part of the right sterno-clavicular articulation. Its length is from 1½ to 2 inches.

In front are the manubrium sterni and the sterno-clavicular articulation, separated from the arterial trunk by the origins of the sterno-hyoid and sterno-thyroid muscles above, and below by the left innominate vein. *Behind* is the trachea; to the *left* is the left common carotid artery; to the *right*, the pleura and the right innominate vein. No *branches* are given off from it normally.

Ligation.—I. The patient is to be placed on the back, with the shoulders slightly raised on a pillow, the head well thrown back over the pillow and the face turned to the left side. The surgeon stands on the right side of the patient, an incision is commenced from the middle line over the trachea and three quarters of an inch above the sternum, and carried outwards parallel to, and half an inch above, the clavicle, as far as the outer border of the sterno-mastoid muscle. Another incision is made upwards, from the inner end of the first, along the anterior border of the sterno-mastoid muscle for three inches. The angular flap thus shaped exposes the sterno-mastoid at its origin. A director or the finger is first passed beneath the sternal, and then the clavicular, head of the muscle, and each is divided, the inner wholly, the outer for about three-quarters of its extent. Reflect the angular flap; search for the outer edges of the sterno-hyoid and sterno-thyroid muscles; pass the director beneath them, raise them and divide. Recognise and open the common carotid sheath, following the artery downwards with the finger, when the innominate will be reached. Pull the pneumogastric nerve and the internal jugular vein outwards and see the subclavian. Clear the innominate artery, as well as possible, from the pleura on the right and the veins in front. Pass the needle from right to left, avoiding carefully the pleura. The description here followed is mainly that given by Mott. II. Sédillot recommends an incision through the integuments along the interval between the sternal and clavicular origin of the sterno-mastoid muscle. It is possible, says Sédillot, when the muscular heads are well separated and the patient's head flexed, to raise the sterno-hyoid and sterno-thyroid muscles, and, cutting them through, to obtain a view of the vessels which would allow of ligature of the innominate, the first stage of the subclavian, the first part of the common carotid, or the vertebral artery.

Of sixteen recorded cases, all have proved fatal except one, in which the common carotid was tied at the same time, and the vertebral artery later for secondary hæmorrhage. Twice the artery has been cut down upon and exposed without a ligature being passed, but good has resulted simply from the manipulation. James Cantlie.

INNOMINATE BONE, Fracture of the. *See* Pelvis, Injuries of the.

INTERTRIGO. *See* Erythema.

INTESTINE, Resection of. *See* Enterectomy; Colectomy.

INTESTINAL OBSTRUCTION.—The conditions which produce an obstruction in the bowels are numerous and varied. They depend upon many different mechanical circumstances, and are the outcome of diverse pathological changes. They can be most conveniently grouped and considered under the following headings:—

1. Strangulation by bands, &c., and through apertures. 2. Volvulus. 3. Intussusception. 4. Stricture. 5. Obstruction by tumours and foreign substances within the bowel. 6. Obstruction by the pressure of tumours, &c., external to the bowel. 7. Fæcal accumulation.

1. Strangulation by Bands, &c., and through Apertures.—Although many different anatomical conditions are met with under this general heading, yet the lesion to the gut, and the method of obstructing it, are practically the same in all the instances. No matter whether the involved loop of gut be ensnared beneath a false ligament, or a Meckel's diverticulum, or an omental band, or compressed by the margins of a normal or abnormal aperture, the intestine so obstructed is strangulated by precisely the same means that are concerned in a strangulated hernia. Indeed, this form of obstruction is practically that of an internal hernia, and the symptoms, and prognosis, and treatment, in the two varieties of obstruction, differ only on anatomical grounds.

The commonest method of strangulation that comes under the above heading is effected by *peritoneal false ligaments.* These ligaments are isolated adhesions, the result of local peritonitis. They are most commonly met with after the peritonitis attending inflammation of the cæcum, or of the connective tissue or viscera of the pelvis, and after that due to injury, to hernia, or to mesenteric gland disease. Adhesions, capable of producing strangulation, may indeed follow any form of peritonitis from which recovery is possible. Many of the adhesions formed during the progress of peritonitis no doubt disappear in time, others persist, and a few are apt to become elongated and cord-like from traction. Often only a single adhesion is found, and hence the term employed by Mr. Gay of 'the solitary band.' The obstructing band is usually narrow, slender, fibrous, and cord-like. Its length varies, and its attachments will depend upon the situation of the causative peritonitis. It is very common for the band to be attached by one extremity to the mesentery. In most instances, the adhesion is found to be stretched in front of a resisting surface, such as the posterior abdominal wall, the floor of the iliac fossa, or a surface of the mesentery, and beneath the arcade so formed a loop of intestine is strangulated. In other and rarer instances, the band is unusually long and forms a loop or noose, in which a knuckle of bowel becomes ensnared, and by which it is ultimately strangulated. In some of the recorded examples, the loop or noose formed has been of a very complicated character.

In another class of case, the band is formed by the omentum, and is called an *omental cord.* In these cases, a part of the free border of the great omentum has become adherent at some spot, and the portion so bound down has developed into a cord-like structure. The attachment of the omental ligament is usually to the parietes or viscera of the pelvis, to the peritoneum in the cæcal region, or to the margins of a hernial orifice. In some cases the whole of the omentum has been rolled up into a fan-shaped structure, the base of the fan being at the transverse colon, and its apex at the point of attachment of the epiploon. More usually, however, the adherent segment separates itself from the rest of the omentum. As a rule, the omental cords are larger, coarser, and of greater length than those last mentioned.

Strangulation by *Meckel's diverticulum* also comes under the above heading. The true or Meckel's diverticulum is due to the persistence, or incomplete obliteration, of the vitelline duct. The diverticulum is always single, and comes off from the ileum from one to three feet above the cæcum. It arises from that side of the bowel which is most remote from the attachment of the mesentery. It is tubular, and its walls have, in all points, the same structure as the small intestine. In its most complete condition, it appears as a tube passing from the ileum to the umbilicus. Much more frequently, however, it forms quite a short projection from the ileum, and, indeed, the average length of the diverticle is three inches. It may be free, or it may have acquired an attachment at its distal extremity. This is more usually to the umbilicus, and is commonly effected by means of a ligament, which comes off from the end of a short tubular diverticulum, and continues the process to the vicinity of the navel.

The end of the diverticle or the cord, which is often continued from its free extremity, may be found attached to other parts, such as the small intestine, the cæcum, and, very commonly, the mesentery. Sometimes, in the position of the diverticulum, no tubular process is found but only a fibrous cord. This cord may represent a greatly atrophied and imperfect diverticulum, or may be the remains of the omphalo-mesenteric vessels. When the diverticulum is free, its extremity may be rounded like that of a test-tube, or it may be tuberose or clubbed, from the development of a false or protrusion-diverticulum.

This abnormal process may cause obstruction in several ways. The adherent diverticulum may form an arcade beneath which a loop of intestine becomes strangulated, or when of good length, and especially when in great part ligamentous, it may form a noose in which a knuckle of bowel may be snared. On the other hand, when the process is free from attachment, and has a clubbed extremity, it may actually tie itself in a knot around the pedicle of a loop of bowel. The precise nature and mode of formation of these remarkable diverticular knots has been well described by Parise.

In the fourth class of case, the strangulating agent may be *a normal structure which has become abnormally attached.* Thus intestine has been found strangulated beneath an adherent vermiform appendix or Fallopian tube, beneath a fixed portion of the mesentery, and beneath the pedicle of an ovarian cyst.

In many cases belonging to the present class, a piece of bowel is strangulated through some *slit* or *aperture.* In the majority of the instances, the slit is found in the mesentery. Some of the mesenteric holes are due to injury, while others are congenital. The congenital apertures are round and regular, and are found in the mesentery of the lower end of the ileum. In other instances, the aperture is in the omentum, and here also it would appear that certain of these unusual holes are due to injury, while others are congenital. A loop of bowel has been strangulated by the margins of the foramen of Winslow, by a slit in the broad ligament of the uterus, and in the suspensory ligament of the liver; by the ring sometimes formed by adherent intestinal loops, by the slit left between two parallel bands of adhesion, and through apertures of like peculiar and rare character.

The general form of strangulation, now under notice, may concern any part of the intestinal canal that is capable of becoming strangulated. The lesion, however, almost invariably concerns the lesser bowel. In some few cases, a part of the colon has been involved, but such instances are quite exceptional. Of the small intestine, the segment most frequently involved is the terminal part of the ileum.

The amount of bowel implicated varies from the smallest knuckle to a mass of intestine measuring several feet. The average length of the involved coil, as gathered from the examination of a large number of recorded cases, is about fifteen inches.

2. Volvulus.—The term volvulus is applied to a condition where the intestine is so twisted that its lumen has become entirely occluded. In one form of volvulus, the bowel is twisted about its mesenteric axis, or even, in rare cases, upon its own axis; while in another form, two suitable coils of intestine are so intertwined or knotted together that obstruction is brought about. The first form of volvulus is comparatively common, the latter is very rare. Volvulus may concern the small intestine, the ascending colon and cæcum, or the sigmoid flexure. It is most commonly met with in the sigmoid flexure. Elsewhere it is exceptional. Indeed, it may be said that the usual form of volvulus is due to a twisting of the sigmoid flexure about its mesenteric axis, and that all other forms of twist are rare.

Volvulus of the Sigmoid Flexure.—The bowel, as has just been observed, is usually found to be twisted about its mesenteric axis. In a normal sigmoid flexure, especially when the loop has but a short meso-colon, volvulus of this kind is impossible. A certain arrangement of the gut is necessary before the twist can be produced. In the first place the sigmoid loop must be of considerable length; in the second place its meso-colon must be long and very narrow at its parietal attachment; and, thirdly, the two ends of the loop of bowel must be brought very close together. When these conditions are found, there exists a free and loose coil, with a narrow and fixed pedicle, around which it can, with great ease, be twisted. This arrangement of the sigmoid flexure is rarely met with except in the bodies of adults, and especially in those past middle life. There is evidence to show that it is most probably brought about by long-continued constipation.

When volvulus occurs, the loop is twisted around its mesenteric axis. The twist is sometimes from right to left, but it is more usually from left to right. When the volvulus has occurred, both ends of the loop are occluded, and the twist is soon rendered permanent. The heavy and loaded coil has no inherent power of righting itself; it soon becomes distended with gas, and this distension renders the volvulus irreducible. If the gas be evacuated, the distorted coil can probably be made to assume its normal position. The distension of the sigmoid loop in volvulus is often enormous. In some cases the involved coil has appeared to occupy almost the whole abdominal cavity. When the distension is moderate, the fundus of the twisted loop reaches the umbilicus; as the distension increases, it tends to move towards the right hypochondriac region, and, in extreme cases, the diaphragm may be pushed up by the dilated coil, and death be brought about by pressure upon the thoracic viscera. The involved loop is found to be intensely congested, and in the condition indeed of bowel in a strangulated hernia. If the volvulus be unrelieved, patches of gangrene appear upon the bowel, and spread rapidly. The colon, above the twist, is found much distended; its mucous membrane is often ulcerated, and such ulceration may lead to fatal perforation. Peritonitis is remarkably common in this form of obstruction. It begins on the involved coil, and then spreads over the rest of the serous membrane. It is rarely absent.

In the other form of volvulus of the flexure, the same anatomical conformation is found in the bowel as in the previous case, and, over or under the pedicle of the loop, a coil of small intestine has passed, and the loop and the coil have become so intertwined as to cause obstruction in both the segments of bowel involved.

Volvulus of the ascending Colon and Cæcum is met with under three aspects:—(1) The ascending colon may be twisted around its own axis. This form of obstruction is, without question, exceedingly rare. (2) The cæcum and ascending colon are together provided with an extensive meso-colon. The free and loose loop of bowel, so formed, may become twisted about its mesenteric axis, or may become intertwined with a suitable coil of the small intestine, just as in the case of the sigmoid flexure. (3) The cæcum is the subject of congenital malformation, and is found to be so bent upon itself, or so twisted about its long axis, that its lumen is wholly, or in part, occluded. The colon, in these cases, is often imperfectly formed, the ascending colon is absent, and the distorted cæcum found in the right hypochondriac region or about the umbilicus.

All these forms of volvulus are rare.

In *Volvulus of the Small Intestine*, as in that involving the sigmoid flexure, two forms of twist may be found. In the one, a loop of the small intestine is twisted about its own mesenteric axis. In the other, a suitable coil of the bowel is engaged in a volvulus with another suitable coil.

It would appear that volvulus is not met with in the small intestine when the anatomical condition of that bowel is in all respects normal. Sometimes, a few adhesions hold the gut down in such a way as to render an irreducible volvulus possible. In other instances, the two ends of a large coil of small intestine are brought together. In this way the coil or loop becomes, to some extent, separated from the rest of the intestine. It has a pedicle, and is in a position to enter into either of the two forms of volvulus. The bringing together of the two ends of the bowel in the loop may be due to some old mesenteric gland disease, or to some local peritonitis involving the mesentery. Volvulus of the small intestine most usually concerns the lower ileum. The involved segment of bowel becomes occluded at both ends, and much distension is produced.

3. Intussusception.—By an intussusception is understood the prolapse or turning of one part of the wall of the intestine into the lumen of an immediately adjoining part. It forms more than one-third of the whole number of cases of intestinal obstruction. When an intussusception is viewed in vertical section, it is found to be composed of six layers of intestine—three on either side of the central canal—all more or less parallel to one another. On horizontal section it shows three concentric rings of bowel. In whatever way the section is made, the arrangement of the layers is found to be such that mucous membrane is in contact with mucous membrane, and peritoneum with peritoneum. The external of the three layers is known as the intussuscipiens or sheath. The innermost cylinder is called the entering layer, and the middle one the returning layer. These two layers, taken together, form the intussusceptum.

There are three anatomical varieties of intussusception:—(1) enteric; (2) colic; and (3) ileo-cæcal. The enteric involve the small intestine, and especially the ileum and lower jejunum. They are usually quite short. The colic may be found in any part of the colon, but are most common in the descending colon and sigmoid flexure. They also seldom attain great length. There are two forms of invagination at the ileo-cæcal region, viz. the ileo-cæcal and the ileo-colic. In the former, the ileum and cæcum pass into the colon, preceded by the ileo-cæcal valve, which forms the apex or free extremity of the intussusceptum. This form may attain great size, so that the valve reaches the anus and projects beyond it. In the ileo-colic form, the end of the ileum is prolapsed through the ileo-cæcal valve. The valve and the cæcum remain, for a while at least, unmoved, and the ileum always forms the apex of the intussusceptum. If the invagination increases after the ileum ceases to become prolapsed, the cæcum and the colon become the subject of a secondary invagination. Leichtenstern expresses the relative frequency of these various forms by the following figures: Ileo-cæcal 44 p.c., enteric 30 p.c., colic 18 p.c., and ileo-colic 8 p.c.

In all forms of intussusception, except the ileo-colic, the invagination increases at the expense of the external layer only. Thus, supposing the end of the jejunum to be invaginated into the ileum. If the mass increase, it will do so solely at the expense of the ileum, and no more of the jejunum will actively enter the intussusception. It thus happens that the apex of the intussusception always remains the same, no matter to what length the invagination attains. In the ileo-colic form, the end of the ileum is prolapsed through the valve, and as the invagination increases, more and more ileum is protruded through the ileo-cæcal opening, while the sheath remains unchanged. When, for various reasons, no more ileum can become invaginated, then, if the tumour increase, the cæcum will be turned in, and after it the ascending colon, the intussusception now growing solely at the expense of the external layer or sheath.

The true or obstructive intussusception must be distinguished from a form of invagination, which is supposed to be due to disordered intestinal movements occurring during the act of dying. These 'intussusceptions of the dying' are always small, are most common in the small intestine, are usually multiple, are frequently retrograde, and are in all instances very readily reduced. They produce no symptoms, and cause, indeed, no material narrowing of the lumen of the bowel. The true intussusception is always descending, i.e. always moves in the direction of the anus. In a few instances a true ascending or retrograde invagination has been met with. Except under the rarest circumstances, the true or obstructive invagination is always single.

Some few cases have been reported of double and triple intussusceptions. In these cases an invagination forms, and then its sheath becomes itself the subject of invagination, so that a double intussusception is formed, composed of five layers instead of three. If the outer sheath of a double intussusception become in turn the seat of another invagination, a triple intussusception is produced, which will be found to be composed of seven layers.

The tumour generally has a somewhat curved outline, especially in the ileo-cæcal forms. This depends upon the traction on the mesentery, and the tumour will therefore be concave on the side to which the mesentery is attached. The traction of the mesentery also tends to make the aperture of the intussusceptum slit-like, and to pull it towards the mesenteric side of the sheath or receiving layer.

Some invaginations may exist for some length of time without the lumen of the involved bowel becoming occluded, and without any gross changes appearing in the layers of the distorted intestine. As a rule, however, the intussusceptum soon becomes engorged with blood and greatly swollen. From this engorgement, coupled with the constriction to which the neck of the intussusception is subjected, the inner and middle layers may soon find themselves in the condition of strangulated bowel. At first, the lumen of the intestine is comparatively free, but by slow degrees it becomes narrowed, and in time most usually becomes quite occluded. This occlusion is due mainly to the great swelling of the intussusceptum, and also to the curving of the tumour from the dragging upon the mesentery, and occasionally to the plugging of the canal with clots of blood. Another important change which is apt soon to take place in the intussusception is this—it becomes irreducible. This irreducibility may depend upon adhesions at the neck or between the opposed serous surfaces of the inner and middle layers, or it may be due to the great swelling of the intussusceptum ; or to the presence of a polyp at its apex, or to some alteration in outline that the invagination has undergone, or—in the ileo-colic form—to the resistance offered by the ileo-cæcal valve. In many, and indeed in perhaps the majority of the cases, two or more of these factors in the production of irreducibility are found to be combined. The intussuscipiens seldom undergoes gross change. It may, however, become the seat of some local peritonitis, or become ulcerated, or even in rare cases gangrenous. With regard to the intussusceptum, it in time tends to become gangrenous. The gangrene is produced by the same conditions which foster it in strangulated hernia. The necrotic process may be limited to some portion of the intussusceptum, or the whole of that part of the invagination may perish *en masse*, and be discharged from the anus. It is by means of gangrene of the intussusceptum that an invagination may undergo spontaneous cure. By this process of elimination several feet of intestine have been separated and evacuated.

4. Stricture of the Intestine.—In stricture, there is a narrowing of the lumen of the bowel, due to changes in the coats of the bowel itself. It is convenient to divide all cases of stricture into two great classes, the cicatricial and the cancerous.

The Cicatricial Stricture depends upon the contracting of a cicatrix, consequent upon the loss of substance by ulceration or limited gangrene of the inner coats. The nature and extent of the stricture produced will obviously depend upon the situation and extent of the original loss of substance. In the majority of examples, the cicatricial stricture has followed upon some primary ulceration of the bowel. Dysenteric ulcers very often lead to stricture. These ulcers are usually met with in the lower parts of the colon, and become rarer as the cæcum is approached. They often cause extensive and very irregular contractions, and may lead to a severe form of stricture. The catarrhal ulcer—met with in acute and chronic catarrh—and the syphilitic ulcer may both be causes of stricture. The former is, as a rule, limited to the colon, the latter occurs most frequently in the rectum and the lower ileum. The peptic ulcer of the duodenum, which is said to be caused by the action of the gastric juice, may also lead to stenosis. Tubercular ulcers of the bowel are also frequent causes of stricture. They are most common about the lower ileum and the ileo-cæcal valve. It would appear that the ulcers due to typhoid fever never produce a very definite stricture of the bowel. In several instances, the loop of gut which has been involved in a strangulated hernia has become the seat of a stricture, the stenosis depending upon cicatrisation after ulceration or limited gangrene of the involved intestine. Certain cases also have been recorded, where a cicatricial stricture has been more or less distinctly traced to the effects of some injury to the bowel.

The Cancerous Stricture. Two forms of cancer are met with in the bowel, the primary and the secondary. It would appear that any form of carcinoma may lead to secondary deposits in the bowel, and those deposits will of course present the same type of structure as is possessed by the primary growth. With this form of carcinoma, surgery has little or no concern.

With regard to primary cancer of the bowel, there are strong reasons for believing that it is strictly limited to one form of carcinoma—the epithelial. There is no evidence of a substantial character to show that scirrhus or medullary cancer ever appears in the bowel as a primary growth.

Epithelioma usually produces very definite and well-defined circular strictures of the bowel. The outer surface of the bowel at the seat of stricture is often very sharply constricted, and presents an appearance as if a piece of cord had been tied around it. The deposit in the interior of the bowel is apt to assume an annular outline, and to be attended early in the case by ulceration. The ulcers have often a thickened, indurated, and everted edge which is very typical.

In any case of stricture, whether simple or cancerous, the intestine above the narrowed part becomes dilated and hypertrophied, and its mucous membrane the seat of ulceration. In stenoses of the colon, ulceration is very commonly met with in the cæcum, even in cases where the obstruction is situated at some distance from the caput coli. It very frequently happens that the ulcer above the obstruction leads to fatal perforation.

Cancerous strictures are much more common than cicatricial strictures, and the colon is much more frequently the seat of the stenosis than is the small intestine. Excluding the rectum, the commonest seat of stricture of the intestine is in the sigmoid flexure; next in frequency comes the descending colon, and then the splenic and hepatic flexures. Indeed, so far as the colon is concerned, it may be said that strictures become gradually less and less frequent as one passes up the intestine from the sigmoid flexure. In not a few instances the stricture has involved the ileo-cæcal valve.

5. Obstruction by Tumours and Foreign Substances.—The following *Innocent Tumours* are met with in the intestine:—Fibroma, fibro-myoma, lipoma, angioma, and adenoma. The last-named is the most common, the other growths are rare. The adenoma grows from the mucous membrane, and is composed of glandular tissue, of the kind found in Lieberkühn's follicles. These tumours nearly always assume a polypoid outline. When the supporting connective tissue of the mass is loose and lax, it receives the name of a soft polyp; when it is more dense and fibrous, the tumour is called a firm or fibrous polyp, or papilloma.

Adenomata are most frequent in the rectum and colon, are most often met with in children, and are more usually multiple than single. After the colon, the lower end of the ileum is the most frequent seat of polypoid growths. Sometimes these growths may attain great size. They may cause obstruction by their great size or by their numbers, and not infrequently they lead to intussusception. In some cases the pedicle of the polyp has given way, and the mass has been discharged per anum.

Sarcomatous Tumours have been met with in the bowel, both as primary and secondary growths. They are usually of the spindle-celled variety. They only very rarely appear as polypi, and more commonly spread around the bowel, and then probably produce one form of what has been incorrectly called a cancerous stricture. In connection with Hodgkin's disease, immense masses of lympho-sarcoma have developed in the bowel from the adenoid tissue in the mucous membrane.

By a *Foreign Body*, as applied to the intestinal tract, is meant any substance that can resist the digestive action of the fluids of the stomach and bowels. These substances may be swallowed by accident or intent, and the victims are very often lunatics or hysterical individuals. Some of the foreign substances which are smooth and rounded, such as pebbles, coins, &c., may pass readily through the bowel, while irregular-shaped bodies, such as pieces of bone and porcelain, and plates carrying false teeth, are very apt to lodge in some part of the canal. The majority, however, of foreign bodies which are swallowed are in time passed by the anus. They may be retained for weeks or even months, and then be evacuated. If obstruction be produced, it most probably depends upon impaction of the foreign body in the lower ileum. The cæcum is another spot where such substances are very apt to lodge. The impacted body may excite ulceration of the bowel. This may lead to perforation and death, or may induce the formation of an abscess, upon the evacuation of which the foreign substance is discharged.

In many instances a *Gall Stone* has become impacted in the intestine, and has led to fatal obstruction. The stone, to cause obstruction, must be of unusually large size, and it is probable that, in every instance, the calculus has reached the bowel by direct ulceration between the gall-bladder and the duodenum. If the stone is able to pass the bile-duct, it will certainly be able to pass through the intestine. When impaction has taken place, the stone is usually found to be lodged in the lower ileum, and next in frequency in the duodenum or jejunum. Impacted gall-stones have induced fatal ulceration and gangrene of the bowel, and have led to the development of fæcal abscesses, through which they have been discharged. These biliary calculi may be retained for weeks or months without causing any symptoms, or, after severe symptoms of obstruction have been produced, they may be spontaneously evacuated.

Obstruction in the bowel may be produced by *Intestinal Calculi* or *Enteroliths.* Some of these concretions are composed of phosphatic deposits, which are usually found to be formed around a nucleus composed of some undigested substance. Such enteroliths are stone-like, are usually single, and of small size. Other enteroliths are of low specific gravity, are porous and sponge-like in texture. These are composed mainly of densely felted masses of vegetable fragments, mixed with calcareous and fæcal particles. To this class belongs the avenolith, or oat-stone, which is said to be met with occasionally in the intestines of those who live largely upon oatmeal. Other of these calculi are made up of hair and fibres, which the patient is in the habit of introducing into the mouth from time to time. Thus a large mass, composed of cocoa-nut fibres, has been found in the intestines of individuals working with that material. In other cases, the concretion is formed of insoluble mineral matters which have been swallowed as medicines. These enteroliths are usually composed of magnesia, and may be of great size. In one instance, it was found to be composed wholly of gum benzoin.

6. Obstruction by the pressure of Tumours, &c., external to the Bowel.—As instances of this form of obstruction may be cited—occlusion of the intestine by a retroverted or retroflexed uterus, especially when enlarged by pregnancy, occlusion by uterine and ovarian tumours, by large abscesses, by tumours of the kidney and other parts, by enlarged spleens, and by hydatid cysts, &c. In this form of obstruction, the rectum suffers the most frequently, and after it the sigmoid flexure, and the terminal coils of the ileum.

7. Fæcal Accumulation.—The morbid condition, which forms the basis of this form of obstruction, is an insufficiency in the forces that move the intestinal contents forward. This condition may pass on to absolute paralysis of a segment of the bowel, leading to complete arrest of the intestinal contents and symptoms of obstruction. In chronic constipation it can only be said that the peristaltic movements are feeble, and inadequate to produce the effects expected of them. In the condition known as 'ileus paralyticus,' or obstruction by fæcal masses, the constipation has led to absolute occlusion of the bowel, and a considerable portion of the intestine is incapable of any peristaltic movements. Fæcal matters collect in this segment, and form a species of plug, which even vigorous action in the bowel alone is not able to dislodge. The retained fæces become more and more solid by absorption of their fluid parts, and the contraction of the empty or less distended bowel below the accumulation adds to the obstruction. As the case progresses, the paralysed intestine becomes more and more distended, its muscular fibres are stretched and even ruptured, and the possibility of a restoration of peristaltic movement is rendered gradually more remote. The condition may be further complicated by the appearance of chronic peritonitis. The gut above the occlusion becomes dilated and hypertrophied, and its mucous membrane the frequent seat of ulceration ('stercoral ulcers.') It is in the cæcum especially that these ulcers are very apt to occur. This form of obstruction is practically limited to the colon, although it may involve the lower ileum. The parts in which the accumulation most often forms are the cæcum and the sigmoid flexure. The dilatation of the bowel above the obstruction often attains enormous proportions, and the amount of fæcal matter accommodated in the bowel in these cases may be very considerable.

Rare Forms of Obstruction.—Among the rarer forms of obstruction which are excluded from the above classification, may be mentioned the following:—Occlusion of the bowel by acute bending or kinking, due to traction upon an isolated adhesion or an adherent diverticulum; occlusion by means of adhesions that compress the gut, and that mat several of the coils together; and narrowing of the bowel from shrinking of the mesentery after inflammation.

The Symptoms of Obstruction.—From a clinical point of view intestinal obstruction may be conveniently divided into three classes :—1, acute obstruction; 2, chronic obstruction; and, 3, cases where symptoms of acute obstruction supervene upon those indicative of chronic obstruction.

1. In *Acute Obstruction* the patient is seized, more or less suddenly, with severe abdominal pains. The pain is of the nature of colic, and is usually constant, although liable to exacerbations. He vomits. The vomiting appears early, is copious, persistent, and in time very commonly stercoraceous. There is more or less absolute constipation, with some distension of the abdomen. There is collapse with great depression of strength, the temperature falls, the pulse becomes rapid and very feeble, the extremities are cold, the face is pinched and the eyes sunken, and the amount of urine is diminished.

2. In *Chronic Obstruction*, on the other hand, the onset is gradual, and the progress of the malady irregular. There are attacks of pain, which come on at first at long intervals, are often provoked by food, and are frequently ascribed to indigestion or colic. These attacks become more frequent, more severe, and of longer duration. They are attended with some vomiting and with constipation. The vomiting is probably slight and the constipation not absolute. Between these attacks the patient may feel fairly well, and suffer only from some abdominal distension, some irregularity of the bowels, with a sense of malaise and with loss of appetite. The attacks become more frequent and severe, the vomiting is more persistent, the constipation more pronounced, and the patient dies, exhausted and marasmic, and worn out by the pain, the continued vomiting, and the inability to take food. The abdomen in such cases may be very much distended, and the movements of the intestinal coils may be visible through the parietes.

3. In the *third class of case* the patient, after presenting for a variable period the evidences of chronic obstruction, succumbs at last to an acute attack. The course of acute obstruction is to be estimated by days, that of the chronic form by weeks and by months.

Before proceeding to the diagnosis of the various special pathological forms of obstruction, it will be convenient to analyse briefly some of the more conspicuous of the symptoms.

Collapse, as an early symptom, is seen only in cases of acute obstruction where the intestine is strangulated. It is due to the sudden lesion inflicted upon the peritoneal and intestinal nerves. The severity depends upon the rigour of the strangulation, the amount of bowel involved, and, to some extent, upon the part involved; for it is apt to be more marked when the active small intestine is involved, than when the more passive colon is the seat of the trouble. The collapse will be obviously influenced by the age and general condition of the patient. In some cases it may be very profound—as profound as the collapse of cholera.

The *Pain* depends, in the first instance, upon the damage inflicted upon the bowel by the strangulation, and, later on, upon the violent and irregular peristaltic movement which the obstruction excites. Pain due to the former cause will be more or less continuous, while that due to the latter will be paroxysmal and colicky. In acute cases, the initial pain is frequently referred to the region of the umbilicus, i.e. to the region of the solar plexus. A continuous pain—even though it present occasional exacerbations—usually indicates complete obstruction, while a distinctly intermittent pain is associated with an incomplete occlusion of the bowel. The early pain in obstruction cases is, as a rule, not attended by tenderness on pressure. This latter symptom is associated with engorgement of the bowel, with long-continued cramp in the intestinal muscle, or with the appearance of local or general peritonitis.

The *Vomiting*, which appears at the very commencement of an acute case, is no doubt due to the lesion inflicted upon the abdominal nerves. The vomiting, in the after-course of the case and in chronic cases, depends, for the most part, upon the obstruction. The bowel above the obstruction becomes distended, and peristaltic movements passing along it induce the backward axial current in the contents, whereby they are poured into the stomach. The persistent vomiting in intestinal obstruction does not require the theory of antiperistalsis to explain it. If the obstruction be at or above the middle of the ileum, the vomited matters cannot become stercoraceous, unless they have been long retained, when, from decomposition, they may acquire a feculent odour. An obstruction in the lower ileum, or in any part of the colon, may be associated with genuine stercoraceous vomiting.

The State of the Bowels will obviously be influenced by the nature and degree of the obstruction. It depends—in cases of partial occlusion—also to a great extent upon the fluid or solid condition of the intestinal contents. The constipation may, in some cases, be in great part due to reflex nerve-action. Thus, in acute strangulation of the small intestine, there may be absolute constipation from the very onset of the obstruction, although the bowel below the occlusion is well occupied by fæces. In intussusception there is—in at least the earlier stages of the malady—diarrhœa. Tenesmus is a marked symptom in cases of invagination involving the large intestine, and is met with also in obstructions that implicate the lower parts of the colon.

The State of the Abdomen.—When the obstruction is complete, meteorism develops. With an incomplete obstruction—especially when a little diarrhœa exists—the abdomen may be quite flat and even retracted. Meteorism is most marked and is earliest seen, when the colon is obstructed. In no form of intestinal occlusion is meteorism at once more sudden and more severe, than in volvulus of the sigmoid flexure. In occlusions of the upper jejunum and duodenum, the distension of the abdomen will be limited to the region of the stomach.

An abdominal tumour may be felt in the following cases:—intussusception, fæcal accumulation, cancer, certain neoplasms, such as lympho-sarcoma, and in some cases of obstruction by gall-stones, foreign bodies, and enteroliths. A number of coils of small intestine, matted together by adhesions, have formed a species of tumour, and a localised dulness on percussion has been caused by collapsed coils of the lesser bowel which have become grouped together below an obstruction.

Local tenderness may correspond to a congested loop of bowel, or may indicate local peritonitis.

The diminished amount of urine passed in many of the acuter cases, does not depend upon the seat of the obstruction, as was once urged, but upon its acuteness, and upon the extent of the damage inflicted upon the nervous system. It is rather one of the symptoms of collapse; it varies with the extent and degree of the collapse and the severity of the pain. In these cases, a marked increase in the amount of urine passed as a rule immediately attends the administration of a full dose of opium.

Differential Diagnosis.—1. The case is diagnosed to be one of *acute obstruction.* The trouble may, in such an instance, be due to—*A.* Strangulation by bands and through apertures, including strangulation by omental cords, by Meckel's diverticulum, by an adherent appendix, &c., strangulation through normal or abnormal slits or apertures, and all forms of internal hernia. *B.* To volvulus of the sigmoid flexure or—in rare cases—of other parts of the colon. *C.* To acute intussusception; and, *D,* To some forms of obstruction by gall-stones, foreign bodies, and enteroliths. *See Table* 1.

2. The case is diagnosed to be one of *chronic obstruction.* The trouble may, in such an instance, be due to—*A.* Stricture of the small intestine, including the many conditions in which the lesser bowel has its lumen partly occluded by compression, by bending, by obstructing substances or new growths. *B.* Stricture of the colon, including the many conditions in which the colon has its lumen partly occluded by compression, by bending, by obstructing substances, or new growths. *C.* Fæcal accumulations; and, *D,* Chronic intussusception. *See Table* 2.

3. The case is diagnosed to be one of *acute obstruction supervening upon chronic obstruction.* In such instances, a form of chronic obstruction exists, in which the lumen of the bowel is only partly occluded, and in which a *complete* occlusion is suddenly brought about. Thus fæcal accumulation may lead to acute symptoms when absolute obstruction is produced. Or a stricture may have become occluded by a sudden bending of the bowel, or by blocking of its lumen by a mass of fæces or of undigested food. Or, again, in chronic intussusception, the lumen of the bowel may become in like manner suddenly occluded, and acute symptoms be thus developed.

In all such cases the previous history of the patient forms the most important element in the diagnosis.

Treatment.—1. *Acute Obstruction.*

A. Strangulation by bands, &c., and through apertures, including the conditions named under the heading in the diagnosis.

The patient must, of course, be kept absolutely at rest. No food of any kind should be given; it merely aggravates the vomiting, and could not be digested even if retained. Ice may be given to suck.

If there be very severe pain with collapse, and greatly diminished excretion of urine, morphia may be administered hypodermically. It must be remembered that morphia can have no really curative effect in these cases, and that it is apt to mask the symptoms, and effect such apparent improvement as even to alter the clinical aspects of the case. Laparotomy offers the only prospect of cure. In this form of obstruction spontaneous relief, while not absolutely impossible, is yet excessively rare, much rarer than the relief of strangulated hernia by spontaneous means. The operation should be performed at once. The simple opening of the abdomen is not in itself a serious measure. The delay is, on the other hand, extremely serious. Laparotomy should be a first and not a last resource. It is as useless to temporise in these cases, as it would be to temporise in a case of strangulated hernia after taxis had failed. For the various details of the operation, and the mortality attending it, *see* LAPAROTOMY.

B. Volvulus of the sigmoid flexure. There is no evidence to show that spontaneous cure ever occurs in this acute affection, when the twist is complete and well-defined. Unless relieved, the condition would appear to be inevitably fatal. The remarks on rest and diet, made respecting the previous form of obstruction, apply equally to this form. Morphia may be administered hypodermically. It stills the peristaltic movements which appear to constantly disturb the involved bowel. In some cases, where the distension of the loop has been relieved, the volvulus has become untwisted. The rectum should be therefore emptied by an enema, and the distended loop punctured through the parietes. Failing relief from this means, left lumbar colotomy should be at once performed. Left inguinal colotomy would merely open the distorted loop, and not the bowel above the obstruction. Attempts to reduce the volvulus, through an incision in the anterior abdominal wall, are not likely to be attended with success. The loop is often of enormous dimensions, and, if untwisted, the volvulus will most probably re-form again.

C. Acute intussusception. No food should be administered, and the patient only be allowed to suck ice. Morphia or opium should be at once given. The drug allays peristaltic movement, and prevents the increase of the invagination. It puts the disturbed parts at rest, and in some few cases—when given early—would appear to have effected a cure. Failing this, forcible enemata should be given. They should be administered by means of a syphon, so that the water can enter the bowel under a steady and easily regulated pressure. If much pain be occasioned, the enema may be given while the patient is under the influence of an anæsthetic. In any case, before the enema is used, the intestinal movements should be stilled by opium. The injection should be retained for at least fifteen minutes. Some surgeons prefer to distend the bowel with air, using for the purpose a common bellows. A better instrument for the purpose, however, is Mr. Lund's inflator (*Lancet*, vol. i. 1883, p. 588). These measures are worthy of a patient trial, and have been followed with considerable success. They are likely to be most effective in quite recent cases. They would obviously be useless when once adhesions had formed, or the invagination had become irreducible for other reasons.

If these measures fail, laparotomy should be at once performed. It is true that acute intussusception may in time take on a chronic course ; but the great majority of the patients die long before they can enter upon the chronic disease, and, moreover, the mortality in chronic intussusception is very high. The general mortality of intussusception is 70 per cent., and 80 per cent. of the patients die before the seventh day. In young children the mortality is terribly high. It is well known that spontaneous cure may take place by elimination of the gangrenous intussusceptum. But such elimination only occurs in 42 per cent. of all cases, and, of those in whom it occurs, there is a subsequent mortality of no less than 40 per cent. The prospects of spontaneous cure by gangrene are too uncertain to be relied upon. As soon as the means already mentioned have had a fair trial and have failed, laparotomy should be performed without delay. In the young it has been urged that the operation should be performed within the first twenty-four or forty-eight hours.

In performing laparotomy the invagination should be reduced when possible, but, failing reduction, the mass should be resected by either of the two methods described under ENTERECTOMY.

D. Acute obstruction by gall-stones, foreign bodies, &c. In several of these cases relief has attended the free administration of opium, followed, after a while, by copious and repeated enemata and gentle laxatives.

Failing relief from these means, there remains no treatment other than by laparotomy and extraction of the foreign body. If the gut at the seat of the impaction be sound, the incision made in its walls may be closed by sutures and the loop returned. If it be gangrenous, or much ulcerated or inflamed, an artificial anus should be established, which can be closed subsequently by a second operation.

TABLE I.—ACUTE OBSTRUCTION.

SYMPTOMS	STRANGULATION BY BANDS, &C., AND THROUGH APERTURES	VOLVULUS OF THE SIGMOID FLEXURE	ACUTE INTUSSUSCEPTION	ACUTE OBSTRUCTION BY GALL-STONES, &C.
SEX; AGE.	More common in males than females. Mostly in young adults. Rare after 40.	Males to females as 4 to 1. Very rare before 40. Most common between 40 and 60.	A little more common in males; mostly in the young. One-half of the cases are under the age of 10.	Gall-stones are much more common in females than males. Average age, 50 to 65.
PREVIOUS HISTORY.	History of previous peritonitis in 68 per cent.	History of long standing, chronic constipation.	Nothing of note.	Gall-stones may have been passed. History of hepatic colic. History of foreign bodies swallowed.
MODE OF ONSET.	Sudden.	Sudden.	Sudden.	Sudden.
PAIN.	Appears early; is very severe; is colicky and persistent; is often situate about the umbilicus.	Appears early. Is severe, but not so severe as in previous case. Is intermittent at first, and then continuous, with exacerbations. Is most felt about navel and region of sigmoid flexure.	Appears early. Is severe at first; then tends to subside. Is at first, usually, distinctly intermittent, then becomes continuous, with exacerbations. May be localised about a tumour.	Appears early. Is severe and continuous, with exacerbations.
VOMITING.	Appears early; is constant, copious, and very severe. In 60 per cent. becomes stercoraceous, on an average, on the fifth day. It gives no relief.	Appears less early, and is less marked and less severe than in previous case. Is often scanty. Is feculent in 15 per cent. It often gives much relief to patient.	Does not appear so early as in the two previous cases. In 8 per cent. there is no vomiting; is often scanty; is liable to great fluctuations; in 25 per cent. the vomiting becomes feculent, on an average, on the fifth day.	Appears early. Is often copious. May in time become stercoraceous.
CONSTIPATION.	Complete and absolute from the first. No discharge of blood from the anus.	Complete and absolute from the first. No discharge of blood from the anus.	Absolute constipation extremely rare; diarrhœa is the rule. In 80 per cent. a bloody discharge from the anus.	Complete from the first. No discharge of blood from the anus.
TENESMUS.	Absent.	Met with in 15 per cent.	Met with in 55 per cent.; is often very severe.	Absent.
PROSTRATION.	Marked. There is collapse, intense thirst, diminished urine.	Not so marked as in previous case. May be collapse and diminished urine. Often severe dyspnœa from distension of the abdomen.	Marked; often severe collapse in the young.	Marked, but seldom so pronounced as in the previous forms of obstruction.
ABDOMINAL PARIETES.	Flaccid, unless peritonitis has set in.	Soon become rigid, owing to early and almost constant appearance of local peritonitis.	Flaccid, unless peritonitis has set in.	Flaccid, unless peritonitis has set in.
METEORISM.	Slight. Seldom appears before the third day.	Appears early, increases rapidly, and becomes very extreme. It often causes displacement of the thoracic viscera.	Is rare, and, indeed, absent, except in cases associated with constipation.	Slight.
ABDOMINAL TUMOUR.	Tumours or limited areas of dulness, due to distended or strangled loops, are extremely rare. Coils of intestine are not visible through the parietes.	No tumour. Coils of intestine are not visible.	A definite tumour in 50 per cent.; is usually in the line of the colon. Is apt to change its place, to increase in size and density during attacks of pain, and to be the seat of tenderness; is dull on percussion. Is not felt over the hepatic or splenic flexures of colon. A tumour may be felt in the rectum, or the invagination may protrude from the anus. Coils of intestine not visible.	Large gall-stones and foreign bodies have in rare cases been felt through the parietes. Large enteroliths may form distinct and hard tumours.
AVERAGE DURATION BEFORE DEATH.	Five days.	Six days.	Of ultra-acute cases, 24 hours; of acute cases, 2 to 7 days; of sub-acute cases, 7 to 30 days.	Seven days.

TABLE II.—CHRONIC OBSTRUCTION.

SYMPTOMS	STRICTURE AND STENOSES OF THE SMALL INTESTINE	STRICTURE AND STENOSES OF THE LARGE INTESTINE	FÆCAL ACCUMULATION	CHRONIC INTUSSUSCEPTION
SEX; AGE.	Non-cancerous strictures occur about early middle life. Cancerous strictures are very rare before 40. Unaffected by sex.	The same.	More often in females than in males. In adults, often in lunatics, hypochondriacs, &c.	More often in males than females, and most common during active adult life.
PREVIOUS HISTORY.	In non-cancerous cases there may be a history of dysentery, tuberculosis, injury, hernia, &c.	The same.	History of long-continued and increasing constipation, with declining appetite, foul tongue, occasional nausea, feeling of languor and depression.	In 35 per cent. of the cases, begins suddenly and becomes after a while chronic; in other cases, commencement may be very insidious.
COURSE.	Very irregular. Acute attacks may appear from time to time, and one such attack may prove fatal. Symptoms often subside or disappear for a while.	The same.	The abdomen becomes gradually distended and the symptoms develop slowly and progressively.	Remarkable by its irregularity and fluctuations.
PAIN.	Intermittent at first, with long intervals of freedom from pain. In time, the intervals become shorter and the attacks of pain longer. Attacks become more frequent and severe. Pain is usually increased by food, especially by indigestible food. When the obstruction is complete, the pain is continuous, with exacerbations.	General character of pain the same, but is less severe. Is as a rule not affected, or but indistinctly affected, by food.	Pain develops gradually. Is at first paroxysmal, then continuous, with exacerbations. At any time evidences of acute obstruction may appear.	Distinctly intermittent. Is of irregular appearance and intensity. Is seldom severe; is often quite insignificant.
VOMITING.	Nausea during earlier attacks of pain. Vomiting during the later and severer attacks. Is often provoked by food. In any case appears late. Is scanty and very rarely feculent except towards end of an acute obstructive attack.	General characters the same. Appears later; is scantier; is not provoked by food; is never feculent except after many days of absolute obstruction. May be entirely absent.	Appears late; is scanty and irregular in its occurrence; is only feculent after a considerable interval of entire obstruction.	Is marked in only 50 per cent. Is of irregular occurrence. Is most often associated with attacks of pain. May be induced or made worse by food. Feculent in 7 per cent. May be entirely absent.
STATE OF BOWELS. TENESMUS	Constipation in 60 per cent. Constipation with diarrhœa in 40 per cent. Constipation absolute during acute attacks. No blood passed per anum. No tenesmus.	Constipation the rule. In cancer, diarrhœa, with constipation, is common. In cancer, blood per anum in 15 per cent. Tenesmus especially in cases with diarrhœa.	Pronounced and increasing constipation. No blood per anum. No tenesmus.	State of bowels varies greatly. Irregular, with sometimes a tendency to constipation, and more often to diarrhœa. Blood per anum in 50 per cent.; tenesmus in 13 per cent.
METEORISM	Absent except during obstructive attacks or with absolute constipation.	Often very pronounced, especially when constipation exists.	Is gradual, progressive, and often considerable.	Absent except during attacks of complete obstruction.
TUMOUR.	In non-malignant cases no tumour. In cancer a tumour in 30 per cent. of the cases. Coils of intestine in movement visible through the parietes.	In non-malignant cases no tumour. In cancer a tumour in 40 per cent. of the cases. Coils of intestine in movement visible through the parietes.	Tumour very usual. Is most often in cæcum or sigmoid flexure. Is firm; may be doughy; is often nodular; may be very large.	Invagination tumour in 50 per cent.; mass felt in rectum in 32 per cent.
GENERAL CONDITION	Patient emaciates, especially in cancer cases. Is worn out by pain and digestive disturbances. May be collapsed during acute attacks.	The same.	Suffers seriously from the occasional obstructive attacks. General condition the same.	The same. Often dies of marasmus.
DURATION.	Three to five months, or longer.	Five to six months, or longer.	Many months.	One to six months, or longer.

2. *Chronic Obstruction.*

A. Strictures and stenoses of the small intestine. In these cases, very special care should be devoted to the dieting of the patient. The food taken should be moderate in amount, should be taken in small quantities at a time, and should be composed only of the most digestible substances. The bowels should be kept properly open by gentle laxatives and repeated enemata. When the condition of the patient becomes more grave, relief may be afforded by enterotomy (*see* ENTEROTOMY); but permanent relief can only be obtained by resection. In simple stricture, in obstruction by innocent neoplasms, in stenoses which cannot be relieved by simpler means, and in epitheliomatous strictures of limited degree, and attended by limited gland-affection, enterectomy offers a means of permanent relief (*see* ENTERECTOMY). Occlusions, due to adhesions, may be treated by the division of the obstructing bands when they are not too extensive, and by enterotomy when the amount of bowel involved forbids the operation of resection.

B. Strictures and stenoses of the large intestine. In these cases, long-continued relief to the more distressing symptoms may be obtained by a careful system of dieting, and by the continued use of gentle aperients and enemata. The operative treatment, suitable for these forms of obstruction, is identical with that advocated in the preceding class of case, colotomy being substituted for enterotomy, and colectomy for the resection of the small intestine. In performing colotomy, it is important that the position of the stricture should be diagnosed, so that the gut be not opened below the seat of the obstruction. The great frequency with which stricture appears in the sigmoid flexure, and the increasing rarity of the affection as the cæcum is approached, should be borne in mind in speculating upon the position of the stenosis. *See* COLOTOMY; COLECTOMY.

C. Fæcal accumulation. The treatment of chronic constipation need not be here considered. The surgical treatment of this form of obstruction is concerned only with cases, where the occlusion has become complete and urgent symptoms have developed. In such cases aperients do more harm than good. Abdominal pain may be relieved by opium or belladonna and warm fomentations to the belly. A very limited diet of carefully-selected and digestible food should be enjoined. In the more active treatment, much good may be effected by the repeated use of copious enemata, and by the evacuation of the contents of the rectum—when that part of the bowel is blocked—by means of the scoop, in cases where enemata fail. Some surgeons advise injection of carbonic acid in this form of obstruction, while others have ascribed the relief obtained to the use of massage of the abdomen and electricity. If all these methods of treatment fail, and the symptoms persist and become so urgent as to threaten life, no alternative remains but to perform colotomy. This procedure is, however, very rarely demanded, and, when performed in these cases, must be regarded rather as a surgical calamity than as a recognised means of treatment.

D. Chronic intussusception. In the treatment of this affection, great attention must be paid to the dieting of the patient. In the most chronic cases, benefit has attended the use of laxatives and enemata. The benefit has been, however, of a temporary nature only. In less chronic cases, and especially in cases attended by pain and distinct intestinal colic, the use of opium is indicated as a palliative measure. Attempts may be made to reduce the invagination by enemata or insufflation. Such measures, however, are almost sure to be attended by failure. The only remaining means is laparotomy, with reduction of the intussusception, if possible, and resection of the mass if reduction be impossible. The extremely fatal character of chronic intussusception forms an urgent argument in favour of interference by operation. FREDERICK TREVES.

INTRAORBITAL ANEURISM. *See* ORBITAL ANEURISM.

INTRA-UTERINE FRACTURES may be produced in three different ways:—1. By external violence or contre-coup. 2. By abnormal muscular contraction in the fœtus or the uterine walls. 3. By injuries during parturition. They may be simple or compound, disunited or united at birth. From the protection afforded to the fœtus by the liquor amnii when the membranes are intact, and from the softness and elasticity of the bones before birth, fracture *in utero* must be of rare occurrence. But the bones are subject to rickets at a very early period, and to faulty ossification with deficiency of earthy material, and in the majority of the cases where fracture has been found, some condition of this kind will have rendered the bones unusually brittle or pliable.

1. There are many cases on record where fracture of one or more bones, and even compound fracture, has been found to exist at birth, which has evidently resulted from some external injury to the mother, generally from falls upon the abdomen. The fractures are often at the epiphyses, but not necessarily so. The following are some of the cases recorded as having occurred after distinct falls upon the uterus: Fracture of the lower end of the tibia; fracture of the lower third of the humerus, ununited; compound fracture of the left femur; fracture through the epiphysis, with separation and displacement forwards and outwards of the inner condyle of the femur; fracture of the middle of the shaft of the femur, from a fall seven weeks before the birth of a seven months' child—the child died twelve days old, and the broken ends were found overlapped and firmly united by callus; a child was born dead with several fractures, three weeks after a fall from a window; another with fracture of the cranial bones with depression, from a severe fall on the uterus; a fracture of the middle of the tibia, ascribed to a fall six weeks before birth—the bone was shortened and bent, the wound still existed at the seat of fracture, and there was callus round both tibia and fibula; a fracture of the left clavicle, with the history of a fall three months before—there was swelling and slight overlapping of the fractured ends; birth of a child four months after a severe fall, with oblique compound fracture of the right tibia and fibula—for some weeks the mother had pain, the uterus being wounded at each movement of the fœtus, there was union at birth, but shortening and wasting, and only three toes, the right arm had also suffered—it was smaller, and had only three fingers. Dr. Flecken gives a case of a powerful woman delivered of a strong, living, full-timed child. After expulsion of a large placenta, another compact fleshy placenta in partial connection with the former followed. The accompanying membranes contained a six months' fœtus, the body of which had been compressed so flat, that the broadest part of the cranial and thoracic regions did not exceed five lines. The bones of the cranium lay separated from each other, the nasal bones projected as sharp points, and the broken malar bone penetrated the skin. While in the sixth month of her pregnancy, the woman had fallen downstairs. When fractures take place at an early period, there is generally arrest of development in the limb affected. Fractures of the cranium are exceedingly rare.

2. Fractures from muscular contraction are generally associated with congenital rickets, or with a cartilaginous or very imperfectly ossified skeleton. They are often multiple. Dr. Barker records the case of a child, which lived only ten minutes, where there was fracture of humerus, radius, ulna, femur, tibia and fibula on both sides; some of the bones being fractured in several places. There was also absence of the frontal, parietal, and expanded portion of the occipital bones, the earthy matter being deficient and irregularly deposited. Dr. Davies gives a case of compound fracture of the femur, the lower fragment overlapping nearly an inch. The child grew to be a man with arrest of development, the limb being only a foot long. Mr. Murray's case, a seven months' child of a syphilitic mother, lived a few days only, the left humerus and left femur being fractured. There are many other cases.

3. The frontal and parietal are the only bones fractured and fissured by uterine contraction in the act of parturition. Defective ossification is usually present. The amount of injury to the vessels is proportionate to the extent of the fracture and the separation of the edges of the bone. In these cases, blood is generally extravasated beneath the periosteum and in the cellular tissue of the scalp. Also internal cephalhæmatoma may occur. Cases of fracture of these bones have been recorded by Dr. West, Dr. Gotz, and others, and there are a number of cases collected by Dr. Schwörer, of Freiburg. Amongst the latter there is one of a child still-born, received into his own hands at birth. The skin over the vertex was found swollen, and there was a large effusion of blood beneath it, especially over the right parietal bone. The bone was fissured in two places. Dr. Michaelis, of Kiel, reports a case of fracture of the right parietal bone in five places, where it came in contact during birth with an immovable coccyx. The head was much disfigured, and in the posterior third of the sagittal suture, where the parietal bones were firm and well-formed and the suture only two lines in width, were seen small livid portions of the longitudinal sinus forced between the bones. Dr. Busch had a case of fracture during birth, in consequence of ankylosis of the joints in the normal position in the uterus. The child was born dead.

The subject of fracture *in utero* is interesting from a medico-legal point of view, as attempts at destruction of the fœtus *in utero* have undoubtedly been made both by the mother and by another person. The points to be determined in such cases are—the nature of the fractures, the condition of the bones, the period of the injury as shown by the presence of callus, &c., and the character of the labour. It is important that the surgeon should be acquainted with the forms of fracture that may occur *in utero* and at birth, independently of any intended violence. They are usually more limited in extent than in criminal cases. No surgeon should give evidence in respect to fractures in the newly born without a full examination of all the limbs of the child, and a careful consideration of the above four points.

The treatment of intra-uterine fractures should take the form of carefully regulated pressure, re-fracture if necessary, and sometimes the division of tendons which maintain deformity. GEORGE COWELL.

INTUSSUSCEPTION. *See* INTESTINAL OBSTRUCTION.

INUNCTION OF MERCURY.—The inunction plan of treating syphilis, though it has of late been superseded to a considerable extent, in this country, by calomel fumigation, and improved methods of administering mercury internally, is certainly in many instances an invaluable mode of applying this agent. When applied forcibly to the unbroken skin, mercury is taken up by the cutaneous glands and hair-follicles, from whence, after a probable conversion into the bichloride, it is transmitted to the general circulation by the lymph-vessels. The usual mode of inunction is, to rub into the skin of a certain region from half a drachm to a drachm of mercurial ointment, and to repeat this daily until a decided effect has been produced on the system and on the course of the disease. This treatment, to prove effectual and safe, must be carried out patiently and industriously, and with strict attention to many small details. The patient should take repeated warm baths during the course, spend at least a quarter of an hour every night in rubbing in the ointment, avoid very carefully exposure to cold and damp, be very temperate as to diet and alcoholic drinks, and keep the mouth in a clean and healthy condition by the frequent use of washes containing chlorate of potash, iodine, or chlorine.

A change should be made every night in the region to which the ointment is applied, the most convenient and suitable parts being the inner surfaces of the thigh and arm, the front of the forearm and of the chest and abdomen. Hairy surfaces should be avoided, as the inunction of mercury is apt to cause some irritation of the hair-follicles. As the manifestations of syphilis subside, the treatment, if tolerated by the system, should be discontinued very gradually. This plan of introducing mercury into the system is usually more rapid than others, and, in many instances, is more efficacious. The whole system is gradually and equably affected, and the mercury does not exert any special and excessive action on the liver and stomach, so that the latter organ, as has been pointed out by Sigmund, is left free for the reception of medicinal agents which may co-operate in the cure or relieve complications. Inunction seems to be specially indicated in cases of acute syphilitic affection of such important organs as the brain, the eye, and the internal ear. This method, however, is sometimes attended with bad effects. The local application of the mercurial ointment may cause a troublesome and obstinate erythema, and even a pustular eruption. Profuse and exhausting perspirations, and also diarrhœa, occasionally interfere with the good effects of the treatment. The objection to the plan of inunction, that it is troublesome and uncleanly, may be overcome by the substitution for mercurial ointment of the oleate of mercury. W. JOHNSON SMITH.

IODOFORM, Surgical Uses of.—This substance, which is chemically allied to chloroform, and contains 96·7 per cent. of iodine, is obtained in the form of small flat yellow crystals. It was first introduced into use, in this country at all events, as an application to chancroids, which fact, taken in conjunction with its tell-tale odour, accounts for the prejudice which to some extent still exists against its use. Since that time, however, its utility has been so marked in a wide variety of cases that its early use is becoming forgotten; although even now attempts are made to disguise its unmistakable odour, which is repulsive to many. Various means have been recommended for this purpose, such as tincture of musk, Tonquin bean, Peruvian balsam. The writer has for some years prescribed an ointment containing ʒj. of iodoform, fʒss. of compound tincture of benzoin to the ℥j. of vaseline; in which form the odour is altered, though not altogether disguised. According to Vulpius, the most agreeable way of applying it is dissolved in collodion, which will take up 15 per cent. of the powder; or in equal parts of turpentine and absolute alcohol, which will take up 4 per cent.; in oil of lavender (7 per cent.), or oil of caraway (16 per cent.).

As before mentioned, it has been and still is used, extensively and most successfully, in the treatment of chancroids and their glandular complications. It appears to have not only an antiseptic, but a soothing action on these sores; and, applied in the form of fine powder, the sores having previously been lightly dried, the risk of auto-inoculation of neighbouring parts is much diminished, especially if followed by the application of collodion, as recommended by Mr. Walter Whitehead. Even in cases where a phagedænic action has set in, and in which, formerly, destruction of the sore with nitric acid would have been indicated, the writer has seen most marked and speedy benefit result from filling the sores with finely powdered iodoform, especially if the part has previously been cleaned with glycerine of carbolic acid. But the success which attended its use in such sores led to its use in the treatment of various foul ulcers and wounds, especially in subjects where there was a syphilitic or a strumous taint. Carbolic acid is, of course, a potent cleanser, but its prolonged use does not promote a healing action; and for this reason the writer had, before the introduction of iodoform, used a combination of tincture of iodine with carbolic acid lotion in the treatment of foul or of indolent wounds, and the action of that mixture much resembled that of the drug now under consideration, in not only purifying the wound, but in stimulating the formation of healthy granulations and producing a typical healthy sore. In sloughing or gangrenous wounds, such as bedsores, iodoform is most valuable. The simplest way of applying it is from an earthenware salt- or pepper-caster. The iodoform may be mixed with any dry powder, such as oxide of zinc or calcined magnesia, or it may be used unmixed; but it should be kept in a cool but dry place. Where it is required to apply the drug to a cavity, one of the various forms of insufflator must be used.

So far as the writer's personal observation extends, he has not met with any case where harm has arisen from its use in this way; but it is well to bear in mind the fact that some cases have been recorded in which alarming symptoms, and even fatal results, have followed the free application of iodoform. (See *British Medical Journal*, June 17 and August 26, 1882.) The symptoms of poisoning are fully described in the articles referred to; but the main feature has been more or less affection of the sensorium, varying from delirium to stupor, accompanied by pyrexia, with rapid pulse and varying elevation of temperature; the symptoms being relieved or removed as the wound was freed from iodoform. Iodoform-wool is an elegant dressing, which is now often used in place of, or in combination with, the Listerian dressings, and is free from any risk of causing constitutional disturbance. With regard to its antiseptic properties, the following observations by Sir J. Lister may be quoted:—'Iodoform, while volatile, is very slowly volatile, and at the same time so little soluble in the discharges that in these points of view it seems an admirable antiseptic; but it is by no means a potent agent in its action on micro-organisms. It is remarkable that iodoform has such an effect as it has in preventing putrefaction; but it is by no means a powerful germicide.'

The following are some of the uses to which iodoform is applied. Finely powdered, it is so unirritating that it has been dusted over the conjunctiva at the first onset of purulent conjunctivitis, and both at this and at subsequent stages it has been found of great benefit; and in the same manner it has been freely applied to the peritoneum after abdominal section. In the form of suppositories, made with cacao-butter, it is used in gonorrhœa, gleet, and in cancerous and other ulcerations of the cervix uteri. A 10 or 15 per cent. solution in collodion has been found a most beneficial application in erysipelas. Internally, iodoform has been given with apparent benefit for ulcer in the stomach, in doses of from three to five grains; also in cases of syphilis, cancer, and in some forms of neuralgia, but with questionable success. So far, its great use has appeared to be as a topical agent. CHAUNCY PUZEY.

IRIDECTOMY. — The operation of iridectomy may be required for various purposes, either for the relief of tension (*see* GLAUCOMA), for neutralising the effect of adhesions, or for the formation of an artificial pupil, through which the patient may obtain vision when the natural pupil is closed or in any way obstructed. When performed on account of adhesions, or for the relief of tension, the piece excised should be the central third of the upper half of the iris, so that the gap is covered by the upper lid, and is neither unsightly nor disturbing to vision. When performed for the sake of making an artificial pupil, the piece selected for excision must be that which will render the artificial pupil most useful. Generally speaking, this will be determined by the state of the cornea, which may be opaque or distorted over some part of its surface, when the surgeon will endeavour to place the new pupil behind the best remaining portion. When there is a choice of situations, an artificial pupil is most useful when it can be made in a direction inwards and a little downwards. Next, as situations of election, come directly inwards, directly downwards, downwards and outwards, and directly outwards, in the order in which they are mentioned. When the only clear portion of cornea is above the pupil, so that the upper lid would interfere with vision through the new opening, good results have been obtained by the subsequent division of all the recti muscles save the inferior, so as to get the upper part of the cornea drawn downwards towards the centre of the palpebral fissure. In operating for the relief of tension, it is necessary to remove the whole width of the iris, right up to its peripheral attachment; and it is best to pursue the same course when operating on account of adhesions. In making an artificial pupil, it is often desirable to leave the periphery, and to cut out a mere notch from the pupillary margin. A small opening affords better vision than a larger one, and exposure of the margin of the lens is apt to produce troublesome distortion of the retinal image, by reason of spherical aberration.

The knife required for an iridectomy will vary with the condition of the eye. When there is a good anterior chamber, so that the lens, iris, and cornea maintain their normal relations to each other, and still more when the anterior chamber is deepened, the ordinary lance-knife is the most convenient. It should not be too wide, and its edges should become parallel at about seven or eight millimètres from the point. When there is high tension, with advancement of the iris and lens, the latter would be in danger of being wounded by the lance-knife before this could penetrate to a sufficient depth to afford the required length of incision; and, in these circumstances, it is necessary to use either a linear cataract knife or a very narrow lance-knife. The other instruments necessary are—an elevator for lifting the upper lid, a fixation-hook or forceps, iris-forceps and scissors, a blunt probe or spatula, some lint, bits of fine sponge, cotton wool, and a bandage. The sponges should be perfectly clean, and moistened with some antiseptic solution—that known as 'Sanitas' being one of the most convenient for the purpose. The eye should be brought thoroughly under the influence of cocaine, and it must be borne in mind that states of high tension interfere with absorption, so that rather more time must be given to the cocaine than would otherwise be required. The best method of applying it is, probably, by the discs rather than by solution, and three discs, each containing the fiftieth of a grain, inserted at intervals of five minutes, will usually be sufficient to render the eye completely insensitive.

Anæsthesia being complete, and the patient suitably placed on a couch in a good light, with the plane of the face nearly horizontal, the surgeon lifts the upper lid with the elevator and commits it to an assistant. He then secures the globe by the hook or forceps, making his fixation close to the corneal margin, at a point opposite to the centre of his intended incision. If necessary, he slightly rotates the globe, imitating the action of the corresponding rectus muscle, but never lifts or pulls it, and simply holds it still, without pressure, when the desired position is attained. If the ordinary lance-knife has been selected, its point is placed on the conjunctiva, a little behind the corneal margin, in the centre of the intended incision, and is made to pierce the sclerotic and to enter the anterior chamber immediately in front of the iris, by a steady gentle thrust directed towards the centre of the eyeball. As soon as the point of the knife can be seen through the cornea, its direction must be changed, the handle being sloped somewhat backwards so as to direct the point forwards in a corresponding degree; and in this position it is pushed steadily on, the operator watching the opposite margin of the pupil to see that the point rides safely over it. Supposing the aqueous humour to be retained, the thrust of the knife should be continued until the incision is of sufficient magnitude; but, if the aqueous humour should escape prematurely, before an incision of sufficient length has been made, the forward thrust must be immediately checked, and the knife withdrawn, lest the lens should be wounded. If the incision is nearly large enough, it may be completed by lateral cutting with the edge of the knife, as it is being withdrawn; if not, it may be enlarged at one or both of its extremities, either by scissors, or by any small knife which has a blunt extremity and a cutting edge. For the relief of tension, the wound should not be less than six or eight millimètres, but for other purposes it may be less extensive.

When the anterior chamber is too shallow for the thrust of a lance-knife to be made with safety, the operator may either take a very narrow lance-knife, the so-called iriddesis knife, or a linear cataract knife. In using the iriddesis knife, fixation should be made at the corneal margin, close to the left-hand extremity of the intended incision. The knife should be carried into the eye close to the right of the fixation-forceps, pushed on in front of the iris until its point nearly reaches the pupillary margin, and then its right-hand edge should be made to cut laterally, against the traction of the forceps, until an incision of sufficient length is obtained. If a linear knife is used, its point must be placed at the outer extremity of the intended incision, and introduced into the anterior chamber nearly as far as the margin of the pupil, over which it must not pass for fear of wounding the lens. It may then either be brought up, so as to effect a counter puncture at the other extremity of the incision, and to divide the bridge of intervening tissue as in cataract extraction (*see* CATARACT) ; or it may be made to cut its way along, just outside the corneal margin, to the required extent, or until the escape of aqueous humour renders the presence of a sharp-pointed instrument in the anterior chamber dangerous. It is of the very first importance that the incision, however made, should be as smooth and clean as possible, and that its edges, whether in the conjunctiva or the sclerotic, should not be jagged or contused.

The section being satisfactorily completed, the eye may be freed from tears and blood by one of the morsels of moistened sponge. The patient is directed to look downwards, and then, if the iris has prolapsed, the surgeon has only to take hold of it with forceps and to perform the excision. If it has not prolapsed, the closed forceps must be passed into the anterior chamber, nearly to the margin of the pupil, and there suffered to expand to an extent proportionate to the size of the piece to be removed. They are then closed upon the iris as it rises between them, and the plait which is seized is drawn gently out of the eye. If the object is only to cut a notch, to serve as an artificial pupil, the first incision through the external tunics may be small, and the scissor-blades may be placed as close behind the forceps as possible, so that only the piece actually held by the latter may be taken out, and the rest suffered or coaxed to return into the anterior chamber. If the object is to relieve tension, the operator cuts in a different direction, close to or even within one extremity of the wound, and quite up to the ciliary margin of the iris. He then tears the piece still held by the forceps from its attachment, as far as the other extremity of the wound, holds it somewhat upon the stretch, and excises it within the lips of the wound as before. If any portion of iris remains entangled at either extremity, an attempt may be made to seize and snip it out, or it may be gently replaced by a small spatula, or caused to return by carefully managed friction. If it should resist these measures it must be left alone, and dealt with on a subsequent occasion. Any coagula between the edges of the incision should be carefully picked out by iris-forceps, and blood in the conjunctival sac removed by the point of a morsel of sponge. A compressive pad and bandage should be applied, and the patient sent to bed. By the third day, or sooner, the wound will usually be healed and the aqueous humour retained, but the blood poured out by the cut vessels of the iris may require a longer time for its absorption, and may keep up some degree of irritation until it is absorbed. During this period, the day should be spent in a dimly lighted room, the eyes should be kept entirely at rest, and the compressive bandage should be worn at night, or during recumbency in the daytime. As soon as the blood has disappeared and the irritation is diminishing, the patient may be suffered to go into the air in favourable weather. Any piece of iris, left incarcerated at either end of the cicatrix, will be itself liable to become a cause of iritis, and may be rendered harmless by being severed, by the thrust of a cutting needle, from the intra-ocular portion with which it is continuous. When an iridectomy has been perfectly performed, it will leave no trace behind except the coloboma which it occasions. The cicatrix of the external wound should after a time become invisible, being neither marked by incarcerated iris nor even stained by pigment.

For cases in which the iris is free and normal, and in which an artificial pupil is required in consequence of central nebula of the cornea, or of small laminar cataract, the writer several years ago devised a method of operating which he described, for want of a better name, as 'optical iridectomy,' and which he has now practised extensively with good results. The object is to cut out a small V-shaped notch from the margin of the pupil, the apex of this notch being directed towards the periphery of the iris. For this purpose, the eyeball being carefully fixed, a puncture may be made at the corneal margin with a narrow iridectomy knife, the blade of which should pass in front of the piece of iris to be excised. The knife should be withdrawn with the smallest possible escape of aqueous humour, and should be replaced by De Wecker's iridotomy scissors, which should be carried closed into the anterior chamber, until the blunt extremities of the blades almost reach the pupillary margin. They are then suffered to expand, and the escape of aqueous humour lifts a small plait of iris between their edges, which plait is excised as they are closed, and may be brought out of the chamber as they are withdrawn. If it should be left behind, as sometimes happens, it may be extracted by fine forceps. In order to protect the lens, the external wound must be immediately in front of the iris, and the scissors must be directed forwards in the anterior chamber. The operation is one of considerable nicety, and should hardly be attempted by anyone who has not had experience in the less difficult manipulations of ophthalmic surgery; but, for certain cases, it affords a better pupil than can be obtained in any other manner.

R. Brudenell Carter.

IRIS, Diseases of the.—In order to understand the diseases of the iris, the principles on which they should be treated, and the consequences which may follow from neglect or from mismanagement of them, it is necessary to remember the structure and functions of the part in which they occur. The iris is an approximately vertical curtain, attached at its outer margin to the ciliary body, interposed between the crystalline lens and the cornea, perforated by a central aperture, the pupil, which varies in diameter with the amount of light falling upon the eye, and largely composed of muscular fibres, some radiating, some circular, by the action of which the diameter of the pupil is controlled. Besides muscular fibres, it is abundantly supplied with nerves and blood-vessels, is covered by epithelium, and, on its posterior surface, by a dense layer of pigment. The physical conditions of its surfaces are analogous to those of serous membranes, and, like these, it is liable to pour out a plastic exudation when it becomes inflamed. The pupillary aperture admits the rays of light to the interior of the eye, and, by its variations in diameter, regulates the amount admitted. In the healthy state, it is exceedingly sensitive to variations in the amount of light, contracting and expanding very freely; but in various states of disease this freedom of movement is impaired or lost. Besides admitting light it preserves a communication between the anterior and posterior chambers of the eye, permitting free passage of fluid from the latter to the former, and thus, indirectly, affording to the fluid of the posterior chamber, and even to that of the vitreous body, access to the circumcorneal zone immediately in front of the iris, a region which has been called by recent investigators the 'filtration area,' and through which the chief transudation of fluid from the eye is now believed to occur. In moderately dilated states of the pupil, the anterior capsule of the crystalline lens is in contact with the pupillary margin, and the centre of the lens projects slightly through the opening; but, when the pupil is widely dilated, its margin is removed from contact with the lens by the curvature of the latter; a relation between the two structures which has an important application in practice.

Coloboma.—The iris is occasionally the seat of a malformation called 'coloboma'—i.e. deficiency—which leaves a gap in some part of its circumference. A coloboma is usually seen extending directly downwards from the pupil, which appears to be enlarged in this direction as if it had been enlarged by an iridectomy. When thus situated, the gap may usually be seen by the ophthalmoscope to extend through the choroid up to the margin of the optic nerve; and, in such cases, it is manifestly due to imperfect closure of the tissues during fœtal life. Less frequently, coloboma iridis is met with in other parts of the circle, when the choroid seldom participates in the defect, the nature of which is then less easily to be understood. Coloboma may be complete, extending through the whole thickness of the iris and up to the ciliary margin, or it may be incomplete in either particular, in some cases consisting merely of a deficiency of the anterior portion of the structure, so that it does not affect the deeper layers and the posterior pigment; in others being a mere notch, extending only part of the way from the pupillary towards the ciliary margin. In all its forms it is an unimportant condition, the worst significance of which is that it may be part of a generally imperfect development of the organ. The practitioner should be on his guard against mistaking it for the result of an operation. In young women with light irides it forms a conspicuous disfigurement; but it is, of course, irremediable.

Cysts and Tumours.—The iris is occasionally the seat of cysts, which are usually congenital, although they may for a long time be so small as to escape notice, and of morbid growths, chiefly either sarcomatous or gummatous tumours. The last-named, of course, require only constitutional treatment as parts of the general syphilitic affection; but both cysts and sarcomata, or tumours of any other kind, should, as a rule, be removed, together with the whole of the portion of iris with which they are connected. In such cases, there will sometimes be a difficulty in making the preliminary incision into the anterior chamber without wounding the cyst or other morbid growth; but this difficulty may be overcome by making two punctures simultaneously, with two very narrow knives, one of which should be introduced on either side of the growth. It will then be possible to introduce a Weber's probe-pointed lacrymal knife through one puncture, and to bring it out through the other, when, the back of the blade being towards the growth, the edge may be employed to divide the bridge between the two punctures. Various attempts have been made to treat cysts by something short of complete excision; as, by excising only the anterior wall, or by free laceration with cataract needles; but these devices have not been followed by a sufficient measure of success to encourage repetition. In several instances acute inflammation has been set up, and the eye either destroyed or greatly injured. For tumours, it is hardly necessary to say, complete removal is the only course, and, until the tumour is in the hands of the surgeon, it will seldom be possible to speak with certainty of its precise nature, or of the chances of recurrence to which the patient may be exposed.

Iritis.—The disease of the iris which demands most attention is inflammation. Iritis is a common affection, liable to occur in both sexes and at all periods of life. Its possible causes are various; its more common causes are injury, some dyscrasia, such as syphilis or rheumatism, and perhaps some forms of perverted innervation. It is often referred to an exciting cause, such as overwork of the eye, exposure to cold, to glare, to irritating particles or vapours; but these conditions, when not sufficiently intense to be included within the general term 'injury,' probably owe their efficacy to some predisposing influence. Iritis is seen under two chief forms—the plastic and the serous. In plastic iritis there is a considerable exudation of lymph, which sometimes forms nodules on the surface of the membrane or at the margin of the pupil, and which frequently produces adhesions of the iris to the anterior capsule of the lens. In serous iritis the effusion consists of turbid fluid rather than of lymph, and the adhesions, if formed, are smaller and less resistant; but the fluid often augments the tension of the eye-ball in a decided manner, and exudation is often deposited upon the inner surface of the cornea in a cloud composed of minute dots, which are usually arranged in the form of a pyramid, with its apex over the pupil, and its base at the margin of the cornea.

Plastic Iritis.—The first *symptoms* by which plastic iritis can be distinctly recognised are four in number, and they are usually all present together. They are: (1) A slight diminution of the ordinary lustre of the iris, with some apparent change in its colour; (2) some degree of impairment of the mobility of the pupil; (3) some impairment of vision; (4) a slight zone of peri-corneal sclerotic congestion. If only one eye is affected, the other must be used as a standard of comparison; and, in testing the mobility of the pupil, the sound eye must be screened from light and the affected eye must be alternately shaded and exposed without being touched. *See* Eye, General Examination of the.

A deceptive resemblance to iritis may occasionally be produced by some affections of the cornea; for a hazy cornea may at the same time conceal the lustre of the iris, diminish its mobility by diminishing the quantity of light which reaches it, impair vision, and be attended by sclerotic congestion. The removal of any doubt, hence arising, may be obtained by the application of a drop of solution of atropia, which for this purpose should not be of lower strength than two grains of the neutral sulphate to an ounce of distilled water. If this fully dilates the pupil within the customary time, half an hour or so, and if the dilated pupil preserves a circular outline, iritis is certainly not present. In actual iritis, generally speaking, even when the patient is seen for the first time, one or more points of adhesion will have formed; and atropia, if it dilates the pupil at all, will dilate it into an irregular outline, which at once renders the adhesions conspicuous. If more time has elapsed since the commencement of the disease, and if the case were either severe originally, or has been rendered so by maltreatment, the pupil may be wholly immovable, either universally adherent or totally insensible to the action of atropia; the surface of the iris may present blood-vessels visible to the naked eye; the anterior chamber may be more or less filled with lymph, partly adherent to the iris, partly diffused through the aqueous humour, and sometimes passing into a purulent condition; vision may be reduced to quantitative perception of light, and the ocular conjunctiva may be intensely congested.

Pain is a very uncertain symptom. It is nearly always present when there is increased tension; but, in other cases, it seems to depend more on the condition of the patient than upon that of the eye. When there is pain, there is nearly always constitutional disturbance, either feverishness and a loaded tongue, with disordered secretions, or else a generally neurotic state, the pain ramifying more or less through the different branches of the fifth nerve, and often assuming an intermittent or paroxysmal character.

Intolerance of light is seldom present; but, when present in any marked degree, it is a symptom of grave import. It indicates at least a tendency on the part of the ciliary body to participate in the morbid action, and it gives to the whole case an entirely new significance.

In the *treatment* of iritis, in all its forms and stages, the first principle to be borne in mind, and to be acted upon in every case without exception, is a negative one. It is to do no mischief; and the only way to avoid doing mischief is to avoid all irritating local applications. In a case of commencing iritis, the application to the eye of a drop of a zinc or silver lotion will stimulate the disease into a state of intensity, which is hardly seen under any other conditions.

In plastic iritis of only moderate severity, which has not been aggravated by any irritant, the tendency is towards recovery; and the indications of treatment are two—first, not to counteract this tendency; next, to prevent the formation of adhesions, or to overcome them if they have formed already. For the fulfilment of the first indication it is necessary to give both eyes complete functional rest, and to protect them from changes of temperature, from irritants, and from glare. The fulfilment of the second indication is to be accomplished only by atropia or some kindred preparation; and hence the effectual use of atropia is the cardinal point in the early treatment of plastic iritis, the one thing which should never be omitted, save in the excessively rare cases in which it is found to act as a direct irritant to the conjunctiva. The margin of the pupil, as already stated, when the opening is of its ordinary diameter, rests in contact with the anterior surface of the crystalline lens. In this position, the effusion of lymph is followed by the immediate adhesion of the structures between which it is interposed. But full dilatation of the pupil removes its margin from contact with the lens, in consequence of the receding curvature of the peripheral parts of the latter. The anterior capsule is then separated from the iris by a film of aqueous humour, into which the lymph projects without becoming adherent, or through which it is diffused. Complete dilatation of the pupil, therefore, presents an insuperable physical obstacle to the formation of adhesions; and, as soon as the pupil is completely dilated, there is nothing more to do than to maintain the dilatation, and the iritis will die out harmlessly.

In order to dilate the pupil, when declared iritis exists, it is best to use a 4-grain solution of sulphate of atropia, and to place a drop within the conjunctival sac every four hours. If the iritis has existed twenty-four hours or more, the atropia will be likely to produce only irregular dilatation, the pupil expanding fully in some directions, while its margin is already fixed at certain points by adhesions. The atropia being continued, recent adhesions will in many cases give way, and when they do so the dilatation becomes complete. The atropia being still continued, the eye recovers in the course of a few days, and the pupil may then be suffered to return to its normal diameter. Complete dilatation is always attended by much relief to the symptoms previously complained of by the patient; but, if atropia is laid aside as soon as complete dilatation is produced, the improvement will often be only temporary. The pupil contracts again, the hyperæmia continues or increases, more lymph is poured out, and adhesions recur. In order to avoid such recurrence, it will usually be sufficient to continue the application of atropia with diminished frequency, as by a single drop night and morning, until all unusual vascularity has disappeared, until the media are clear, and until natural vision, save for the action of the atropia, is restored. When recovery is apparently complete, the atropia may be laid aside; but the eye must be carefully watched during the first few days, and the slightest blush of renewed congestion would call for an immediate return to the remedy.

When plastic iritis is of a high degree of original severity, or when it has been aggravated by improper treatment, or even when it has been suffered to exist for some days unchecked, a state is produced in which atropia fails to exert its customary influence. Either the dilatator muscle is paralysed by the inflammation, or the greater part of the iris is adherent, or these conditions co-exist. The adhesions remain unaffected, and the intermediate portions of the pupil will only dilate partially and sluggishly, if at all, showing that the muscular fibres act only imperfectly, even where the margin is free. In such conditions, the demand for mercury is imperative; and its constitutional action must be obtained as rapidly as prudent administration will allow. It may therefore be said, as a rule, that it is sufficient at first to prescribe atropia solution for a case of iritis, which is at once mild and recent. But if, when the patient is first seen, the attack has been running on for a day or two, and is even moderately severe, it is better to prescribe mercury as well as atropia, giving perhaps two grains of blue-pill twice a day. In forty-eight hours, if the pupil is well dilated, the mercury may be laid aside; but, if the pupil has resisted dilatation, the mercury must be pushed, with the knowledge that the quantity already taken has laid the foundation of the effect which it is desired to produce. This effect should not exceed the formation of the slightest mercurial line upon the gums; and it should be maintained until resolution of the inflammation is accomplished. Improvement usually commences almost simultaneously with the first appearance of the mercurial line; and absorption of the effused lymph often proceeds with great rapidity. As the lymph disappears, the pupil yields more and more to the atropia, and, in favourable cases, rupture of all the adhesions may be produced.

The influence exerted upon iritis by mercury, and the necessity for administering it in certain cases, seem to be essentially independent of the syphilitic or non-syphilitic character of the affection. A patient who has iritis may also have syphilis, and may require mercury on account of that syphilis; but, speaking with reference to the iritis alone, the writer is not accustomed even to take into consideration, as a question bearing upon treatment, whether the iritis is syphilitic or not, but accepts resistance to atropia as a sufficient proof that mercury is needed.

It sometimes happens that iritis is attended, from the first, by an unusually active degree of vascular excitement. The face will be somewhat flushed; the eyelids hot, the temporal pulse increased in fulness and force. In such circumstances the action of atropia will be resisted, but it does not follow that mercury will be required. Before prescribing it, an endeavour should be made to subdue the vascular excitement, and, if this can be accomplished, complete dilatation of the pupil will often follow. A case might occur in which it would be proper to take blood from the arm; but two or three leeches to the temple, near the margin of the orbit, will generally be sufficient. Whenever there is evidence of active congestion, coupled with resistance to atropia, some form of depletion should precede the administration of mercury, and, if the pupil then become dilated, should supersede it. If there were any strong reason for abstaining from depletion, a minim or two of tincture of aconite might be given every fifteen minutes, until a manifest diminution of vascular excitement was produced.

When iritis is attended by pain, this may arise from either of two widely different causes, and may assume either of two widely different characters. It may be the pain of hyperæsthesia, of nervous exaltation or irritation, or it may be the pain of tension, due to the stretching of the ocular tunics by increased secretion within. The former is usually more or less neuralgic and paroxysmal, the latter is usually described as a permanent sensation of fulness, aching, stretching, or weight. But verbal descriptions of pain have no common measure; and, whenever pain is experienced in iritis, the state of tension of the eyeball must be carefully and frequently examined, and any decided increase must be diminished by paracentesis or iridectomy, according to circumstances, which will presently be considered. Pain of an irritative or neuralgic character must be subdued; for it may be laid down as a general principle that improvement is not to be expected while it continues. Until recently, the best way of subduing it was by the hypodermic injection of morphia; but the application of cocaine to the conjunctiva furnishes a still more valuable resource. A single cocaine disc, containing the fiftieth of a grain, will often afford relief in a few minutes, and may be repeated, without any countervailing disadvantage, whenever a return of pain may render it desirable.

The pain of increased tension is perhaps most frequent in 'serous' iritis, but it occurs also in the plastic variety. It calls for the prompt evacuation of the contents of the anterior chamber. For this purpose, the eye being rendered insensitive by cocaine, a broad cutting-needle or a cataract-knife, or, in default of these, almost any sharp-pointed cutting instrument, should be thrust into the anterior chamber immediately in front of the iris, and withdrawn. A fine probe may then be introduced through the opening, and used to press back the posterior edge of the puncture until all the fluid contained in the anterior chamber has escaped. It is not safe to use the cutting instrument for the purpose of evacuating the fluid, inasmuch as the iris, or even the lens, might easily be wounded against its point. When carefully performed the little operation is free from risk, and may be repeated as often as the tension is restored, although a single puncture will frequently be sufficient. The evacuated fluid is usually yellow and albuminous, and its escape restores the natural colour of the iris, showing that the change in this respect, which is almost universal in iritis, is due to the change in the medium through which the surface of the membrane is seen.

By the foregoing means, by atropia, with or without mercury, and with or without local depletion and paracentesis, nearly every case of plastic iritis may be conducted to a successful issue, so far, at least, as the subsidence of the inflammation and the restoration of good vision are concerned. In some cases, however, adhesions remain, and these cases cannot be said to be cured. In a few instances no further mischief may ensue, but in the majority the adhesions will become exciting causes of recurrent inflammation. As a rule, the eye in which iritis has left a partially adherent pupil will suffer from iritis again. The function of the muscles of the iris is to regulate the diameter of the pupil in response to every variation in the quantity of light which falls upon it; and an adhesion is a perpetual obstacle to the discharge of this function, and serves to check the variation of the pupil abruptly, whenever it passes a certain limit. As an almost necessary consequence, the adhesion becomes a source of irritation, and maintains a condition of preparedness to inflame. Accidental injury, overwork, or general disorder of the health, finds in the affected iris a part in which the natural vital resistance of the tissues is diminished, and in which morbid action is readily set up. The second attack of iritis, in such circumstances, falls upon an eye in which there is a mechanical impediment to the dilatation of the pupil, so that the parts of its margin adjacent to the existing adhesions must remain in contact with the capsule of the lens, and are thus liable to be rendered adherent themselves. Under judicious treatment, the second attack will generally subside, but not until it has added to the extent of the adhesion left behind by the first.

When one recurrence has occurred, others are almost sure to follow; and each will bind down more and more of the pupillary margin, until at last this is rendered entirely adherent, and there is no longer any communication between the anterior and the posterior chambers. The resulting state is called, not very felicitously, 'exclusion of the pupil,' and, before it is produced, there is usually a good deal of lymph deposited over the whole of the anterior pole of the lens, which lymph, as it undergoes shrinkage, drags the pupillary margin together, and assists in closing the opening. As long as the pupil is not entirely 'excluded,' as long as there is an aperture even the size of a pinhole, the case may be amenable to treatment; but as soon as the pupil is entirely closed, a fresh series of changes will commence. The quantity of fluid contained within the eye, is regulated by the preservation of a certain balance between the internal secretion and the exhalation which occurs chiefly at the angle of the anterior chamber. When once the pupil is closed, the effect of this exhalation no longer extends to the regions posterior to the iris; and the fluids of the posterior and vitreous chambers, although continually increased by fresh secretion, have no longer any sufficient outlet, and hence rapidly increase the tension of the posterior parts of the eye. They push forward the peripheral or non-adherent zone of the iris, and thus afford evidence of the completeness of the 'exclusion,' which may be known to exist whenever this peripheral zone is stretched, convex, and prominent, while the central or pupillary portion of the iris is comparatively flattened or receding. In such circumstances all the tissues of the eye, probably already damaged by repeated inflammation, undergo speedy atrophy. The iris tissue wastes, the vitreous body becomes fluid, the lens becomes opaque and often calcareous, and the retina perishes in the common ruin. There can be no more hopelessly spoiled organ than an eye in which recurrent iritis has been suffered to run its course unchecked, and to produce its ordinary consequences.

It is therefore a matter of primary importance, in dealing with a first attack of iritis, to prevent the formation of adhesions, and it should never be forgotten that this can be done, with a very near approach to certainty, by the early and efficient use of atropia. When, from any cause, the atropia has not been efficiently used in time, or when its action has been resisted, and the inflammation subsides leaving an adhesion behind, such a condition must not be accepted as a recovery. In the first place, an endeavour should be made, after the subsidence of the inflammation, to detach the adhesion, or, if it cannot be detached, to stretch it, by the continued use of atropia. Very considerable adhesions will sometimes yield if the pupil is kept fully dilated, and if mercury is cautiously administered. If an adhesion, without being ruptured or detached, can even be stretched into a linear band, it may afford the iris sufficient freedom of play; and it may generally be assumed that the action of atropia and mercury cannot be profitably continued for more than about a month. The condition which remains at the end of that time may safely be regarded as an established one, or at least as incapable of being altered except by operative interference.

The effect of adhesions in producing secondary iritis may probably depend somewhat upon their precise position with regard to nerve-filaments, upon their extent, and upon personal peculiarities. As these are uncertain elements, and as, in a few cases, secondary iritis does not occur, no operative interference with the adhesions left behind by a first attack can, generally speaking, be recommended. The exceptions to this rule are furnished by patients who are about to undertake long voyages, or to travel in countries where they might not, in the event of a recurrence, be within reach of skilled treatment. But after a second attack of iritis has occurred, there is no longer much prospect of escape from others, and the conditions previously existing become wholly changed. If successive recurrences are permitted, it is probable that total and incurable blindness will be produced in the course of a few years; and the only way in which this danger can be obviated is by the detachment of the adhesions or by the performance of iridectomy.

Detachment of adhesions may be accomplished in two ways: either by the operation of Mr. Streatfeild, or by that of Dr. Passavant.

Mr. Streatfeild's operation, to which he has given the name of 'corelysis,' is performed by making with a cutting-needle a puncture through the cornea, about midway between its summit and its margin, at a point opposite to the adhesion to be detached. The 'corelysis hook,' a fine and narrow spatula with a notch on one side, is introduced through the puncture, carried between the lens and iris, and so manœuvred as to engage the adhesion in the notch and to break or cut it by traction across the pupil towards the puncture. Dr. Passavant's operation consists in detaching the adhesions by forceps traction, in a direction towards the ciliary region instead of away from it. He makes a small incision with an iridectomy knife in the corneo-scleral junction, on the same side as the adhesion, and, so to speak, behind it. He then introduces forceps like common iris forceps, but without sharp teeth, so that they hold without wounding; seizes with them a fold of iris just behind the adhesion, and draws it towards the wound, as if he were going to draw it out for an iridectomy. As soon as he sees the adhesion yield he ceases his traction, suffers the forceps to expand, and withdraws them empty. If a portion of iris should prolapse through the wound, it is replaced by gentle rotatory friction through the closed lids, or, if that should fail of effect, by the extremity of a blunt probe. The eye, after either operation, is bandaged and treated in the ordinary manner, and is brought as soon as possible under the full influence of atropia, in order to dilate the pupil and to prevent reunion of the adhesion.

The writer has practised both these operations frequently, and has been induced by experience to abandon that of Dr. Passavant entirely, and to reserve that of Mr. Streatfeild for cases in which there is only one adhesion, or two placed near together, and in which there are strong cosmetic reasons for avoiding iridectomy. Upon a pretty girl with blue irides and well-opened eyes, to whom an iridectomy, even at the upper part of the circle, would be a serious blemish, it would be legitimate to perform corelysis, but hardly in any other circumstances. It is a fault common to both the operations that they must be repeated nearly as often as there are adhesions to be dealt with. When two adhesions are close together, they may be torn through by forceps traction from a point between them, or may be included in one sweep of the corelysis hook; but, if they are too far apart for either of these procedures, they will generally require distinct operations, separated by a sufficient interval of time. For every adhesion there must be a point from which the traction ought to be made in order to be most efficacious; and if a second or even a third adhesion can be reached from the original wound, yet the hook or forceps will act at a mechanical disadvantage in detaching it. Moreover, however fully the eye may have been brought under the influence of atropia, the evacuation of the aqueous humour, and the irritation of the iris by instruments, will produce a contraction of the pupil by which the exact position of any remaining adhesions will be concealed; and it would not be prudent to make casts with a hook in the mere hope of catching something, or to pinch up iris here and there without good reason. A still more serious fault, also common to both operations, is that the adhesions, when detached, sometimes reunite while the external wound is healing, so that the objects of the operation are defeated. Lastly, in some cases, opacity of the crystalline lens has followed the traction. If this had only occurred after Mr. Streatfeild's method, it might be supposed that the capsule had been injured by the hook. But it has occurred also after the use of the forceps, which were separated from the lens by the iris, and never entered the region of the pupil at all; so that it is manifest that the capsule itself may sometimes tear, instead of, or together with, the adventitious band. Dr. Passavant's method, moreover, labours under a disadvantage which is all its own—namely, that an adhesion is liable to be formed between the cicatrix of the wound of entrance and the peripheral part of the iris. Such an adhesion might be both concealed and unsuspected; but it would not be any the less likely to occasion future attacks of inflammation. It may be admitted that with Mr. Streatfeild's hook, especially if the notch is made large enough to receive a cutting edge, a single adhesion may often be safely and certainly divided, with only a small chance that it will reunite. But when the adhesions are multiple, the chances of reunion are greatly increased, and the risks of producing new peripheral adhesions or opacity of the crystalline lens are too serious to be disregarded.

From the foregoing objections the remaining resource, iridectomy, is wholly free, and it has the additional advantage of being of almost certain efficacy in preventing the recurrence of iritis. Even if it should fail in this, it will at least prevent occlusion of the pupil by any ordinary attacks, inasmuch as a large gap in the peripheral portion of the membrane is hardly ever filled up and dragged together by lymph, except when the operation is performed in the course of irido-choroiditis, and fails to arrest it. It matters little what part of the iris is removed, and it is not at all necessary, nor in any way specially advantageous, to remove the adherent portions. The effect seems to be produced by breaking the continuity of the muscle; and hence the operation may be localised with reference to two chief considerations, vision and appearance. If the natural pupil is obscured by lymph, the artificial one made by the iridectomy should, if possible, be placed where it will be most useful for visual purposes—that is to say, downwards and inwards, inwards, or directly downwards. By choice, in these circumstances, the part excised should not include an adhesion; because this, when detached, is liable to leave a patch of hardened lymph and uveal pigment upon the surface of the capsule, and these residua would themselves interfere with sight. When the natural pupil is clear, and the vision nearly normal, the iridectomy should be made directly upwards, where it will be at least partly and sometimes entirely concealed by the upper lid; and it is then a matter of indifference whether the part to be removed is adherent or free.

The writer's experience of iridectomy, performed after a second attack of iritis and as a means of preventing further recurrence, is now large, and it is altogether favourable. The operation is scarcely ever followed by any kind of ill-consequence, and it scarcely ever fails of its object. When both eyes have been affected, the writer has in several instances operated first upon the worse of the two, with the result that it shortly afterwards became the better of the two, and that its increased usefulness and comfort occasioned a request that the other might be similarly treated. In many persons, the existence of an adhesion, while the iris is entire, is attended by painful sensations of dragging, and by congestion of the eyes after even moderate use, long before recurrent inflammation is excited. All symptoms of this kind are relieved by the iridectomy.

After several attacks of iritis, in some of which the choroid and vitreous have probably to some extent participated, and when the greater part of the pupil is adherent, the operations of Streatfeild and of Passavant are impracticable, and the performance of iridectomy is the only resource remaining to the surgeon. In these circumstances, the amount of benefit to be obtained must depend upon the actual condition of the organ, and the operation is no longer entirely free from risk.

Even a first attack of iritis does not invariably follow the favourable or partially favourable course which has been described. In certain states of bodily health, in cases in which the malady has been neglected at the outset, and still more frequently if the eye has been maltreated by nitrate of silver drops, or in any other manner, the inflammation may extend to the ciliary body and choroid, and may place the sight in great peril. In iritis which implicates the choroid the pupil is often obstinate in its resistance to atropia, and, in cases in which the cornea and aqueous humour retain sufficient transparency, dilated blood-vessels may often be seen upon the surface of the iris itself. The ciliary region is usually somewhat tender to the touch, the hyperæmia more pronounced, both in the conjunctiva and in the sclera, than in the simple iritis; and the impairment of sight is usually much greater than can be explained by the lymph-deposits in the pupil, or by the turbidity of the media in front of it. The ultimate tendency is to destruction of sight by wasting of the eyeball, and by complete separation of the retina from the choroid by effusion of lymph or serum. The effusions which proceed from the choroid not infrequently undergo calcareous degeneration, and in course of time they are occasionally converted into true bone, furnished with Haversian canals.

When extension of iritis to the ciliary body and choroid occurs in a case which has been under observation and skilful management from the outset, the prognosis is in the highest degree unfavourable, and the surgeon has to witness the effects of a process against which he is almost powerless to contend. It is only in irido-choroiditis which has not been treated, or which has been maltreated, that there is any hope, although even then not a large one, of arresting the morbid process, and of preserving a useful amount of vision. Our resources for this purpose are much the same as in the more severe forms of iritis, and their employment should be governed by the same principles. Unless there be some special contra-indication, the constitutional effect of mercury should be obtained as rapidly as possible. Pain should be subdued by anodynes. The strength should be supported by well-chosen diet; strict repose and protection from all irritants should be enforced; and any constitutional conditions which may be contributory to the disease should receive their due share of attention.

In such cases the pupil is usually completely closed, and, even if there be any portion of its margin which is not adherent, the muscular tissue of the iris is too profoundly modified by the inflammation to respond to atropia. In such circumstances, no good is to be expected from its employment, and it will sometimes act as a local irritant. The surgeon should bear in mind the general principle that the use of atropia, in iritis, is to dilate the pupil; and that, if the pupil cannot be dilated, the drug is superfluous, and may be hurtful. Iridectomy has often been performed in such conditions, but seldom, if ever, with benefit. The operation is attended by very free bleeding from the cut iris, and the anterior chamber becomes filled with a coagulum, which conceals the iris and pupil, often occasions great irritation, and is only very slowly absorbed. However large the piece of iris removed, the resulting gap will gradually be dragged together by lymph, and the occlusion of the pupil restored. A better resource is repeated paracentesis. If the anterior chamber be tapped, and its contents evacuated, in the manner already described, and if the puncture be re-opened with a probe sufficiently often to prevent it from healing, there will be no effusion of blood to do mischief, but a constant drain of fluid which must be supplied from the dilated veins of the eye, and which must in some degree diminish their congestion. The little wound is too insignificant to be hurtful, and the advancement of the lens and iris, consequent upon the frequent withdrawal of the aqueous humour, may prevent injurious pressure from being exercised upon the retina. If improvement be obtained, it is manifest that an iridectomy will eventually become necessary for the restoration of sight; and it should be performed during the first distinct remission of the inflammatory symptoms, before the lymph, which has been effused in the stroma of the iris, has had time to become a source of fresh mischief by the traction consequent upon its shrinkage. After the iridectomy, the treatment must be continued on the same general principles as before; and it will frequently be some months before the effused matters are fully absorbed, the media transparent, and such an amount of sight restored as the injury done by the inflammation may permit. It is not uncommon for the lens to be rendered opaque, or for its surface to be entirely covered by a semi-opaque film, and in either case it may eventually require removal. See *Secondary Cataract* under CATARACT. During the subsidence of the disease, and the period of the absorption and removal of morbid products, the most important questions to be considered will usually have reference to the continuance or disuse of mercury, and these can only be determined by watching its action in each individual case, or, sometimes, by tentatively withholding it for short periods of time.

It is manifest that inflammation of the iris and choroid cannot exist without inflammation of the intervening ciliary body, or 'cyclitis,' as this affection has been somewhat clumsily called. But in some cases the cyclitis is a subordinate, while in others it is a prominent symptom; and, in the latter class, there is great danger of the occurrence of 'sympathetic ophthalmitis,' that is to say, of the excitation of an insidious and almost invariably destructive form of irido-choroiditis in the previously unaffected eye. Such an event is most frequent when the original inflammation was traumatic in its origin, and especially when the ciliary body has itself been injured, and is, therefore, primarily affected, the iritis and choroiditis being secondary phenomena. For further information on these points, *see* EYEBALL, Injuries of the; CILIARY BODY, Diseases of the; SYMPATHETIC OPHTHALMITIS.

Serous Iritis is met with under two principal forms, in one of which the cornea participates, while in the other it escapes. In the former, the disease usually commences in an insidious manner, with little increase of vascularity, and the patient first complains of dimness of sight. The surgeon may then find one or two points of adhesion, a slight dulness and discoloration of the iris, and a fine cloud on the lower part of the cornea; which cloud, when carefully examined, is seen to be composed of an aggregation of minute dots on the inner surface of the membrane. The cloud is usually triangular in outline, its apex being in the pupillary region and its base at the inferior periphery of the cornea. There will, perhaps, be a slight zone of pericorneal vascularity, a slight increase of tension, and the second eye will, usually, be attacked in a similar manner. The disease was described by old writers as 'aquo-capsulitis,' and is apt to pursue a very chronic course. It is prone to occur in syphilitic subjects, but the writer has seen many instances in patients in whom no syphilis was discoverable. Complete functional rest of the eyes, protection from strong light and from changes of temperature, the use of atropia for the adhesions, attention to the general health, and the careful administration of iodide of potassium or of perchloride of mercury, with or without iron, and over a considerable period of time, will usually conduct such cases to a favourable termination. Such an administration of mercury as has been recommended for acute plastic iritis will seldom or never be required. If adhesions are left, when recovery is otherwise complete, they must be treated upon the general principles already laid down.

The other form of serous iritis, in which the cornea does not participate, is of a more acute character, and may be described as an attempt at acute iritis in a person incapable of yielding plastic lymph. The patients are often the subjects of some dyscrasia, often of renal disease. The effusion is more abundant than that of plastic iritis, and remains fluid, not producing adhesions, but distending the anterior chamber, pushing back the plane of the iris, indirectly increasing the tension of the whole eyeball, and thus producing great obscuration of vision. Functional rest, the relief of pain, and repeated paracentesis, constitute the chief treatment which will be required. If the tension is very high, and if the surgeon cannot see the patient frequently, so as to evacuate the contents of the anterior chamber twice a day, it will often be best to perform iridectomy. This procedure is usually followed by uninterrupted recovery; but the writer has operated on one case in which the distension had been so great, before the iridectomy was performed, that it left behind five dioptres of myopia in an eye which had previously been emmetropic.

R. BRUDENELL CARTER.

IRRIGATION, or the plan of allowing gentle and continuous currents of liquids to flow over parts of the body, is an old therapeutic resource, possessing unquestionable antiphlogistic power. Irrigation may be practised with water of variable temperature, pure or medicated; but plain cold water is most frequently employed. As the fall of temperature from evaporation is considerable, it is rarely necessary or safe to irrigate with iced water. Dry cold (*see* COLD) is, on the whole, more useful and manageable than wet; but irrigation does possess special advantages. This is more particularly the case in treating diseases of, and in cleansing, cavities such as the nose, the pleura in empyema, the bladder, vagina, and rectum. In these cases, the best and simplest plan is to irrigate on the syphon principle, through an elastic tube deriving its supply from a vessel on a higher level than the body. In treating wounds, especially foul ones, irrigation has the advantage, over stagnant wet, of promoting drainage by carrying off secretions as rapidly as they are formed; and it is readily intelligible that any antiseptic may be added to the liquid, if it be thought desirable to do so. The discomfort from wetting the body and bed-clothing is an objection to irrigation, and, to make it tolerable, every care must be taken to direct the outflow by adjusting the position of the body, and in making the bed, placing the pillows, and covering with waterproof cloth. The combination of position and irrigation greatly enhances the antiphlogistic power of the latter, as by elevation alone of an inflamed limb its supply of blood may be greatly reduced, and with it the temperature, all the more so if the raised limb be continuously irrigated.

Water may be allowed to flow from a tap or to drop on to a joint from a wide-necked bottle suspended over it, with some skeins of cotton hanging out of the bottle; or the liquid may be suspended in a small can or bucket, and left to trickle through an elastic tube, regulated by a stop-cock or a cleft stick at its lower end. Dr. James Macartney, in his *Treatise on Inflammation*, gives the following directions: 'Having laid some lint on the inflamed part, let the water be conducted by means of a strip of woollen cloth from a vessel holding the water or other fluid, which may be placed on a chair or table standing beside the bed. One end of the strip is to be inserted into the vessel; the other, which should be cut into a pointed shape, laid on the lint. The water will then proceed in the manner of a syphon continuously from the vessel, not by drops falling from a height, the sensation of which is disagreeable.' The important question as to how long irrigation should be continued, must be determined by the circumstances of particular cases. As a rule, it requires to be kept up for many hours, often for several days, before its beneficial effects are fully realised. The details of the method employed for irrigation are matters of secondary importance, affording great scope for ingenuity. The physical principles in operation are essentially those of the syphon and evaporation, and the patient's comfort is the best measure of the good done.

Sampson Gamgee.

ISSUES are ulcers artificially produced and prevented from healing by the irritation of a foreign body; they may be employed as counter-irritants, and have been used to produce a continuous drain from the system.

Issues may be established by—1, caustics; 2, the moxa; or, 3, the knife; and in making them, bony prominences and the situation of nerves and vessels should be avoided.

1. To make an issue with caustic, the skin around should be protected by a piece of plaster, with a hole half the size of the required issue in the middle of it; a bit of caustic potash or Vienna paste, about the size of a pea, should be placed in the hole, and retained there by another piece of strapping for about three hours or fifteen minutes, according as the potash or the Vienna paste is used.

2. To make an issue by means of the moxa, a holder, known as the porte-moxa, having a wire-gauze receptacle at one end, is useful; some cotton-wool, tightly pressed and impregnated with nitrate of potash, should be placed in the gauze cage and ignited, and then held in contact with the skin until it is burnt. After both these methods, the injured part should be fomented to soothe the pain and irritation, and hasten the separation of the slough.

3. The knife is the least painful instrument for making an issue, but it is not so satisfactory as the other methods, on account of the difficulty of keeping the issue open. To make the issue, a crucial incision should be made through the skin by transfixion and cutting outwards, and into it a glass bead, known as the 'pea,' should be placed, in order to prevent healing and set up suppuration.

If the issue be inclined to heal too quickly, it may be dressed with savine ointment, or painted with liquor epispasticus.

Bilton Pollard.

ITCH, the popular name for Scabies. *See* Scabies.

J

JAW, Dislocations of the Lower.—Owing to the bony walls of the glenoid cavity, dislocation of the lower jaw is only possible in one direction—viz. forwards, over the eminentia articularis. The luxation is usually *bilateral*, but sometimes *unilateral*, and occasionally *congenital*.

The *bilateral dislocation* generally occurs during the act of yawning or laughing, when the mouth is widely opened, or it may be caused by straining the jaws apart, as in an attempt to bite a large apple. Rarely, it has been caused by violence. If the finger be placed just in front of the tragus whilst the mouth is being opened, the condyle of the jaw will be felt to pass downwards and forwards on the articular eminence, and it will be readily understood how, if the movement be carried beyond its natural limit, the condyle might slip over this bony ridge into the zygomatic fossa. Dislocation occurs less frequently in youth and age than in the middle period of life, a fact which may be to some extent explained by the obtuse angle which the ramus forms with the body of the jaw, towards the extremes of life.

Bilateral dislocation is almost invariably caused by muscular action, the mechanism of which is as follows. The digastrics, mylo-hyoids, and genio-hyoids draw the body of the jaw downwards towards the hyoid bone, which is in its turn fixed by the muscles passing from its lower border; then the external pterygoids complete the dislocation by drawing the condyles, together with the inter-articular cartilages, forwards over the eminentiæ articulares. When this has happened, the contraction of the masseters and internal pterygoids tends to maintain the dislocated position. The pathological results are stretching or slight laceration of the capsular ligaments, the carrying forward of the inter-articular fibro-cartilages upon the condyles of the jaws, slight laceration of the temporal muscles, and stretching of the lateral ligaments, the external ligament being directed downwards and forwards, instead of downwards and backwards.

The *symptoms* are gaping of the mouth with projection and fixation of the jaw. The saliva dribbles over the chin, deglutition and speech are interfered with, and the articulation of labial sounds rendered impossible. Immediately in front of the ear is a hollow whence the condyle has been displaced, and anteriorly, below the malar bone, is a projection caused by the coronoid process, whilst above the zygoma is a prominence produced by tension of the temporal muscle. The displacement gives a stupid expression to the face, and the patient, unable to express himself, points helplessly to his mouth in a manner apt to excite laughter rather than pity.

The *treatment* usually adopted is to place the patient in a chair, with his head supported against the back or by an assistant, and to introduce between his teeth the thumbs protected by lint, one on either side, in order to force the jaw back into position. The thumbs rest on the molar teeth and make pressure downwards and backwards, whilst the fingers are used to raise the chin. Another plan is to seat the patient on the floor and fix the back of his head between the knees of the operator. Two corks, two pieces of firewood, or the handles of a couple of forks are then introduced between the molar teeth, one on either side, and the surgeon placing both hands beneath the chin draws it steadily up. The condyles are thus directed into place by the jaw rotating on these artificial fulcra. A third method, recommended by Nélaton, is to press with the thumbs directly upon the coronoid processes so as to force the rami of the jaw backwards. Mr. Golding-Bird succeeded in reducing a case of eighteen weeks' standing by this method, one side being reduced before the other. Mr. Pollock reduced a case of four months' duration by placing wedges between the molar teeth and drawing the chin up by a Petit's tourniquet carried over the top of the head.

Unilateral dislocation gives rise to a projection of the jaw towards the sound side, and there exists a hollow just in front of the ear on the side whence the condyle is displaced. The deformity is not so obvious as in the bilateral dislocation, but articulation, closure of the mouth, and deglutition are all interfered with. It is, as a rule, more readily reduced than the bilateral, and by similar means.

Congenital dislocations are usually associated with deficient brain-development. *See* CONGENITAL DISLOCATIONS.

Subluxation of the jaw was described by Astley Cooper as occurring from relaxed ligaments. The condyles ride too far forward on the articular eminences, and, becoming temporarily fixed, then slip back with a jerk. *See* TEMPORO-MAXILLARY ARTICULATION, Diseases of the.

In long-standing cases of unreduced dislocation the jaws become more nearly approximated, the deformity diminishes, and the lips may be brought into contact.

R. CLEMENT LUCAS.

JAW, Fracture of the Lower.—Fracture of this bone is apt to be overlooked. It is most common just in front of the mental foramen—i.e. near the canine tooth; but it may involve any part of either the horizontal or ascending ramus. Rarely it traverses the symphysis; occasionally it extends through the neck; or the coronoid process may be broken off. Fractures of this bone are often multiple or comminuted, and generally compound. Its arched formation and loose connection enable the jaw to resist considerable force. It is broken only by great violence, which is generally direct, in the form of blows or kicks; but the condyles may be broken off by falls on the chin, and the symphysis by lateral pressure, as when a wheel passes over the side of the face.

Symptoms are displacement, mobility of the fragments, crepitus, pain, free bleeding. Displacement is sometimes great, but it is often slight. Its direction depends on the line of the fracture, and therefore varies in different cases. The anterior fragment is generally drawn down by the digastric and other muscles, and lies internal to the posterior. Fracture is apparent in the altered outline of the teeth, which, however, it must be remembered, are often naturally very irregular, and in distortion of the outer surface and lower border of the bone. Mobility and crepitus are best detected by the tips of the fingers placed on the teeth, if the jaw can be opened, and the thumbs on different parts of the ramus; or the fragments may be manipulated from without. But roughness is unjustifiable, and even gentle examination causes severe suffering. There is dribbling of the saliva and fœtor of the breath. The inferior dental nerve usually escapes injury, but in some cases it has been torn through. Necrosis is not a rare consequence, especially in instances in which the injury has been overlooked, or when the fracture is compound and comminuted. Salivary fistula is rare. Troublesome suppuration is occasionally met with, which is generally associated with necrosis. Teeth that are much loosened are generally best removed. A tooth dropped into the fissure may hinder replacement. The condyles may be so forcibly driven up in falls on the chin that the base of the skull is injured.

Treatment.—As impaction is extremely rare, the adjustment of fractures of the body or symphysis is generally easy, though it may be difficult or impossible in fractures of the coronoid process or of the neck, especially if, as has sometimes occurred, there is dislocation also. Should the fragments be interlocked, an anæsthetic may be required. In a few cases of interlocked oblique fracture it has been necessary to saw off part of one of the fragments. This, however, can very seldom be called for. Retention is often easy, but it may be very difficult, especially in multiple or comminuted fracture.

I. In simple cases, the four-tailed bandage, the ends of which cross each other as they leave the symphysis, the two upper tying at the nape, the two lower over the vertex, will suffice.

II. A splint may be thus made. A piece of brown paper, six inches by four, is made four-tailed by cutting lengthways inwards from its ends to within an inch on each side of its centre. This is then shaped to the symphysis and body of the jaw, its two upper ends passing horizontally backwards and the two lower ends being brought vertically upwards across them. A gutta-percha splint is then cut out to this model, and (after the face has been shaved and well oiled to prevent sticking) when softened in hot water is moulded over the jaw, its ends being turned as those of the paper pattern were. It should be lined with lint, and kept in position by a four-tailed bandage.

III. As the splint just described is apt to press the anterior fragment backwards, Hamilton's splint is preferable. It consists of (*a*) a firm moulded cap (of leather or gutta-percha) for the symphysis and body of the jaw, the ends of which, prolonged with webbing, pass straight upwards in front of the ear and buckle at the vertex; (*b*) of a band encircling the head on the level of the forehead and occiput, and furnished with loops at the temple through which the ends of *a* are passed; (*c*) of a band passing longitudinally over the head, and connected with *b* at the forehead and occiput, and to which *a* is also fastened at the vertex. Thus *b* and *c* keep *a* in place.

IV. The fragments may be fastened together by a ligature passed round adjacent teeth to secure fixation; or an interdental splint may be made as follows:—A thick piece of cork is mortised on its upper and lower surfaces, so that the upper and lower teeth fit into it tenon-like, and so that it deeply overlaps the lower teeth laterally. A similar but better mould is made of gutta-percha, softened so that it accurately shapes itself to the teeth. With this splint Hamilton's bandage should be used.

V. Hammond's wire splint may be used. This excellent appliance is thus made:—A mould of the teeth is taken in soft wax, from which a plaster cast is made. To this cast is fitted a piece of stout wire, skirting the outer surface of the teeth, doubling round the wisdoms, and continued so as to skirt the inner aspect also. Its ends are now soldered together. When accurately fitted to the cast, this frame is slipped over the patient's teeth, and its inner and outer portions are fastened together by wires passing between the teeth at convenient intervals. This splint allows the patient to open and close his mouth and clean his teeth—a privilege that none should despise. Sometimes the fragments, otherwise not to be kept in place, can be drilled and wired together—a troublesome operation. Union seldom fails, but it is often tedious, especially if the fragments are not securely fixed. If it is delayed, examination for sequestra should be carefully made. If suppuration occurs, the mouth must be frequently rinsed with Condy's fluid, or borax and chlorate of potash lotion. HOWARD MARSH.

JAWS, Closure of the.—Inability to separate the jaws may be temporary or permanent. In the former case, setting aside cases of *trismus* from nervous affections, the cause is contraction of the muscles of mastication, especially the masseter, due to irritation from an uncut wisdom-tooth. Owing to want of room between the second molar and the ramus of the jaw, or owing to some malposition of the tooth itself, the wisdom-tooth is unable to assume its normal position, and by the pressure which it exerts on the neighbouring structures, sets up irritation, which induces a state of tonic spasm of the masseter and internal pterygoid muscles.

The majority of these cases occur, as might be anticipated, about the age of twenty; and the diagnosis is easy, unless very great swelling, and possibly abscess, should have supervened and obscured the nature of the case. The treatment consists in administering chloroform thoroughly, so as to relieve the spasm somewhat and allow of the introduction of a screw-gag between the teeth, in order to separate the jaws. This must be done slowly and steadily, so as not to inflict injury upon the front teeth, and the back of the jaw may then be reached. If the wisdom-tooth is presenting in its normal position, a free division of the gum over it, and removal of the flaps thus made with scissors, will be sufficient treatment, if the patient can quietly bear a little inconvenience for a time. But when there is obviously not space for the wisdom-tooth to be erupted, room must be made by extracting the second molar, unless the wisdom-tooth itself can be reached and extracted, which is seldom the case. Occasionally the extraction of the upper wisdom-tooth, against which the lower wisdom-tooth is pressing injuriously, may completely relieve the trouble.

In whatever way room is given, relief is sure to follow, and in the course of a few hours the spasm of the muscles passes off.

PERMANENT CLOSURE OF THE JAWS may depend upon destruction of the temporo-maxillary articulation, or more frequently upon the contraction of cicatrices in the cheek, following ulceration or sloughing. This latter condition is frequently the result of gangrenous stomatitis occurring in childhood, in which case destruction of the whole thickness of the cheek not infrequently takes place; but the same result may follow an attack of fever, &c., at any age. When the mischief is confined to the lining membrane of the cheek, the soft parts become firmly adherent to the alveoli of both jaws, and a rigid cicatrix of fibrous tissue, in which bone not infrequently develops, binds the jaws firmly together.

Under these circumstances, the patient is often nearly starved, for he can only rub soft food between the teeth, or push it with the finger behind the teeth on the unaffected side. In the cases where destruction of the cheek has taken place, although the deformity is more unsightly the patient is generally able to feed better, particularly if one of the molar teeth is wanting.

The treatment of cicatrices by simple division within the mouth is perfectly futile, for although wedges may be employed for a time to keep the jaws apart, they will certainly be drawn together by the rigid contraction of healing. In order to secure improvement in the patient's condition, it is necessary to prevent the adhesion of the cheek to the alveoli, and to restore, as far as possible, the pouch of mucous membrane between them. This can only be done by adapting to the teeth metal plates, or shields, which can be constantly worn after free division of the cicatrices, and which, reaching well beyond the gums, can prevent adhesion taking place between the cheek and the alveoli. After a long time, a formation of mucous membrane takes place in the sulcus thus formed, and the plates may then be dispensed with in the daytime, but must be worn for many months at night. It is obvious that treatment of such a protracted nature cannot be carried out in children, and that the co-operation of an able mechanical dentist is essential for success.

The method is applicable only to cases where the whole thickness of the cheek is not involved; but the extent of the adhesions is comparatively unimportant, since the plates can be adapted to both sides of the mouth.

In the case of unilateral adhesions, division of the lower jaw in front of the cicatrices, and the formation of a false joint, give very good results. Esmarch removed a wedge-shaped piece of bone, so as to secure fibrous union with free mobility, while Rizzoli contented himself with dividing the jaw from the mouth, and trusted to the subsequent movements to establish a false joint.

Esmarch's operation is a very simple one—an incision along the lower border of the jaw easily admitting of the use of a narrow saw for the removal of a wedge of bone, the base of which should be below. The only point of importance is that the section should be made thoroughly in front of the cicatrix in the cheek; for, if this is not attended to, the operation will fail. The operation is applicable to cases in which one side of the mouth is affected, and restores to the patient a very useful, though one-sided amount of masticatory power in two or three weeks, with very little suffering or annoyance.

One side of the jaw remains of course permanently useless, and there is necessarily some deformity left, but the relief is permanent.

A patient, upon whom the writer operated in 1864, called in 1880 to show how satisfactory the movement of her jaw was. *See* TEMPORO-MAXILLARY ARTICULATION.

CHRISTOPHER HEATH.

JAWS, Diseases of the.—PERIOSTITIS, both acute and chronic, affects the jaws; but the former is so prone to run into suppuration with consequent necrosis, that it is only in the early stages that it can be recognised. The more chronic form is commonly connected with syphilis, and leads to the formation of nodes about the palate, and enlargement of portions of the lower jaw. In these latter cases the administration of the iodides, in full doses, gives most satisfactory results. Many cases of persistent facial neuralgia, which are unrelieved by quinine, &c., yield to the administration of iodide of potassium, and may be concluded to depend upon chronic periostitis or ostitis, with, probably, pressure upon the dental nerves.

NECROSIS affects the lower, much more frequently than the upper jaw, probably in consequence of its being less abundantly supplied with blood. Beginning as periostitis, from tooth-irritation, injury, or the action of some specific poison, the general symptoms are pain, with pyrexia; and the part affected will be found to be swollen, injected, and hot, the teeth being raised from their sockets and unable to bear the slightest pressure. If relieved by timely depletion by leeches, or, better, a free incision, and the assiduous use of hot gargles and poultices, the symptoms may subside without further mischief; but usually matter has already formed beneath the periosteum before the patient is seen, and then, although promptly evacuated, necrosis is very apt to follow. Fortunately, necrosis sometimes affects the outer plate of the alveolus only, so that the teeth are supported by the inner plate, and can be kept *in situ*; but when the entire socket is involved, the teeth are rendered loose and useless, and are better away, since they only plug the openings through which the discharge should find its way out. It is very undesirable to attempt the removal of sequestra until they are completely loosened, since, by doing so, damage may be inflicted on the surrounding parts, and the process of repair be interfered with; and this is especially the case in children in whom the second teeth are still undeveloped.

It is impossible to lay down any rules for the period of separation, which must depend upon the extent and position of the sequestrum, and the strength of the patient; but ordinarily from six weeks to three months must elapse before large sequestra can be safely extracted.

By *exanthematous necrosis* (Salter) is meant the necrosis occurring in young children, for the most part, after attacks of the specific fevers, especially scarlet fever and small-pox. Necrosis of portions of the alveolus of either jaw, and usually on both sides symmetrically, or even of the whole thickness of the lower jaw, is fully recognised now as one of the sequelæ of these disorders; and doubtless many of the cases which were attributed to the administration of calomel in former days, were really due solely to the action of the specific poison. The course and treatment of these cases differ in no respect from those of ordinary necrosis.

The action of the fumes of *phosphorus* in producing necrosis of the jaws in persons employed in lucifer-match making, has now been recognised for upwards of forty years. It was found that so long as workers with phosphorus had perfectly sound teeth, their health remained unaffected; but so soon as the teeth became carious, or were from any cause extracted, the fumes of phosphorus found their way to the periosteum of the jaws, exciting periostitis with rapid necrosis.

The symptoms were severe, the swelling of the jaws and tissues of the face being extreme, and the discharge of purulent fluid from the mouth being constant and in large quantities. The general health became secondarily affected, the patient being worn out with pain and inability to take solid food, and in very severe cases being liable to gangrene of the gums and cheeks. All these discomforts have been put an end to by insisting upon cleanliness in the use of the phosphorus, by the careful examination of the mouths of the workers, but more especially by the employment of the amorphous phosphorus in the manufacture of lucifer matches.

The remarkable point about phosphorus-necrosis is the peculiar deposit of pumice-like bone, which takes place upon the sequestra. This is doubtless derived from the periosteum, although so closely adherent to the sequestrum as to be invariably brought away with it; and though resembling true bone in some particulars, it is decidedly of a lower development. A form of bone, closely resembling this pumice-like deposit, has, however, been noticed in cases in which no phosphorus was involved, and it would appear that, in some instances, possibly of rheumatic origin, the deposit of new bone partakes of this character.

Besides phosphorus-necrosis, *mercurial* necrosis was once common, not only as a consequence of the excessive administration of mercury for antisyphilitic purposes, but as a result of the destructive ptyalism produced by the fumes of liquid mercury as formerly employed in the manufacture of looking-glasses. When glass plates were converted into mirrors by sliding and compressing them on to sheets of tin-foil covered with pure quicksilver, the men employed were liable to have their teeth drop out, and frequently lost portions of the jaws, their lives being notoriously shortened. Since the introduction of a chemical process by which the mercury is deposited on the glass, these cases of induced necrosis have become almost unknown.

In ordinary cases of necrosis of the *upper* jaw, no reproduction of bone takes place, the gap left in adults being permanent, though in children the subjects of exanthematous necrosis, the granulation-tissue is slowly converted into fibrous tissue, which does not as a rule ossify. In the *lower* jaw, abundant new bone is produced by the periosteum, and, for a time at least, most extensive losses are repaired. It is certain, however, that, in course of years, a great, if not complete, re-absorption of new bone thus formed takes place, the patient being left ultimately with very little, if any, support for artificial teeth. Salter has suggested that the early application of artificial teeth would tend, by use, to strengthen and maintain the permanence of the new bone; but there are no facts to support this view.

Under the name HYPEROSTOSIS may be conveniently grouped together a number of cases in which general enlargement of the maxillary bones occurs, without any tumour which could be properly placed among the osteomata. Enlargement of the angles of the lower jaw, quite unconnected with the development of the teeth, and giving a peculiarly broad appearance to the face, occurs in otherwise healthy subjects of about twenty, and they appear to remain stationary. In true hyperostosis, however, there are large bosses of bone, often symmetrical, thrown out by the bones of the face and cranium, which slowly but steadily increase in size, producing hideous deformity, and ultimately causing the death of the patient. Cases in which the disease is unilateral may fairly be submitted to operative procedure, and the writer has twice relieved patients from considerable deformity by sawing or gouging away a portion of the projecting bone, without any external incision. In one case, that of a lady aged 39, the enlargement of the right upper jaw was attributed to a blow on the cheek; in the other, a man aged 46, the enlargement in the same situation came on apparently without cause. *See* OSTITIS DEFORMANS.

Cysts occur both in the upper jaw (*see* Antrum, Diseases of the) and in the lower, where they may be single or multiple. The origin of these cysts is probably in the cancelli of the bone, and is in many cases due to the irritation caused by neighbouring teeth; a cancellus being filled with fluid expands, and produces gradual absorption and obliteration of neighbouring cancelli, until a cyst of considerable size is produced.

The multilocular cysts of the lower jaw appear to be more closely connected with the teeth than the single cysts, since, in many cases, the extraction of teeth or stumps gives exit to a quantity of glairy discharge. Distension and absorption of the alveoli go on as the cysts increase in size, so that the walls at length become membranous, and the macerated bone shows great gaps in its outline. One remarkable clinical feature in these cases is the length of time over which they extend, without materially affecting the health of the patient, except by their size and the consequent inconvenience produced.

The *treatment* of multilocular cysts in the lower jaw depends somewhat upon the extent of the disease and the amount of solid growth connected with them. Removal of any portion of the whole thickness of the jaw should be avoided as far as possible, though this may be advisable in extreme cases. Mason Warren and Butcher have shown that by evacuating the contents of the cysts from within the mouth, and crushing in the thin walls with the fingers, a great amount of consolidation can be brought about, and if the thick lower border of the jaw be unaffected, as it usually is, a very firm basis of support for artificial teeth may thus be obtained. The operation may require repetition, and will give satisfactory results when there is little, if any, solid material connected with the cysts. When there is a solid growth in connection with the cysts, it may, if small, be removed with the gouge, but if it should be reproduced, the portion of jaw involved should be excised, since experience has shown that these growths in connection with cysts are epitheliomatous, and apt to become generalised throughout the body.

Tumours.—Non-Malignant.

I. Fibroma of the jaws closely resembles fibroma in other parts of the body, and especially the uterus. It is dense in structure, and frequently lobulated, and on section shows interlacing bundles of fibres. Two varieties of origin are found, the periosteal, springing generally from the alveolus, and indistinguishable except by its size from epulis, and the endosteal, which springs from the interior of the bone, and in the upper jaw generally makes its way into the antrum and nasal cavities, or in the lower jaw expands the inner and outer plates of compact bone. Fibroma produces absorption by pressure, and may thus destroy a great part of the skull; it stretches the skin of the face, and may by tension produce ulceration, and thus cause an aperture, but it never involves the skin, which is always loose and movable over the tumour.

Fibroma appears to owe its origin, in many cases, to the irritation of decayed teeth, which may sometimes be found embedded in the tumour or displaced by it. No treatment less radical than the removal of the portion of bone, from the periosteum of which the tumour springs, can be of avail in the periosteal variety of fibroma; but in the form in which the bone, and particularly the lower jaw, is expanded by a slow-growing tumour within it, less heroic measures may be successful. The writer has removed a fibroma by enucleation from within the antrum with complete success, and numerous museum specimens serve to show that the lower jaw is often expanded by fibrous tumours, which are amenable to the same treatment.

II. Enchondroma is of less frequent occurrence in the jaws than fibroma, and like it may be divided into periosteal and endosteal. The disease appears ordinarily early in life, springing from the surface of either jaw, or from within the antrum or the interior of the lower jaw, and grows steadily, and more rapidly than the fibroma.

It is more tuberous than the fibroma and harder than it, and, in the case of the upper jaw, is apt to send processes into the fissures and cavities of the skull, thus giving rise to great deformity by involving the nose and orbit. Many remarkable specimens of this kind are to be found in museums, the patient in some cases being suffocated by the growth involving the mouth and pharynx. And yet in these cases it will be seen that the tumour does not invade the surrounding parts except by its pressure, and could have been enucleated.

Enchondroma has undoubtedly a greater tendency to recur locally than has fibroma, and it is essential, therefore, in its treatment that free removal should be undertaken. Enchondroma of the jaws may have fibrous tissue mixed with it, or may in great part be converted into bone, and no doubt many of the remarkable osseous tumours of the jaws to be found in museums were originally cartilaginous in their nature.

III. Osteoma is found in the jaws as a cancellous or as an ivory tumour.

The simplest form is the condensed hypertrophy due to the presence of a misplaced tooth; and the fact that numerous serious operations have been performed in these cases, should make the surgeon especially careful as to his diagnosis. The cancellous osteoma has a covering of compact bone of varying thickness, but sometimes so thin as to crackle under the finger. It grows slowly to a very large size, but when removed by section of the healthy bone beyond, shows no tendency to reproduction. The ivory osteoma is met with both as an outgrowth from the lower jaw and as a tumour of the upper jaw, of which the ivory is but a portion, the rest being composed of dense cancellous bone. *See* Exostosis.

In the *treatment* of these tumours, an exploratory puncture or trephining may enable the tooth, which is the cause of the malady, to be extracted, and hence this should never be neglected, except in the case of the ivory growth. This again may be sawn off, and shows no tendency to recur, or may be extracted from the cavity of the antrum, or from the interior of the lower jaw. As a last resource the upper jaw, or a portion of the lower, may be removed with the tumour, but extensive mutilations should not be undertaken for benign and slowly increasing tumours, if they can be avoided.

Under the old term 'Cystic-Sarcoma,' was included more than one variety of solid growth in which cysts were developed. The presence of cysts was held to mark the non-malignant character of the disease, and the clinical histories of recorded cases appeared to support this view. The naked-eye appearance of the solid growths was that of a fibrous or fibro-cellular tumour, and this was considered to be its nature until the last few years.

In his 'Erasmus Wilson Lectures' for 1882, Mr. Eve fully discussed the question of these tumours being really a variety of epithelioma; and certainly the fact of a solid tumour forming after thirty years' existence of cystic disease, as occurred in a patient of the writer's, would tend to show that the disease in question is not so harmless in its course as has hitherto been supposed. Still the clinical history of these cases, and also of the cases of ordinary 'cystic-sarcoma,' differs so completely from that of ordinary epithelioma as to rapidity of progress and recurrence after removal, that further observation is necessary before a decided opinion can be arrived at on the whole question.

Sarcomata.—In connection with the jaws, various forms of sarcoma are found, many of which have hitherto been known by other names, and many recurrent growths, formerly called cancers, come properly into this class.

1. Spindle-celled Sarcoma is of frequent occurrence about the jaws, forming many of the specimens formerly indiscriminately named 'osteo-sarcoma.' The principal clinical features of spindle-celled tumours of the jaw, are rapidity of growth with invasion of surrounding parts, but no glandular infiltration, at least in the earlier stages. Free removal is essential because of the tendency to creep along the periosteum beyond the defined tumour, which is common in these cases, and recurrence is frequent. A remarkable feature in the recurrent growths is the tendency to become softer with each recurrence, and the patient dies worn out, with, rarely, secondary deposits in internal organs.

2. Round-celled Sarcoma (encephaloid sarcoma of Cornil and Ranvier and others), is a more vascular and softer growth, and hence has more of the character of a malignant tumour. It grows very rapidly, invading the skin and forming fungous protrusions, and leads to deposits in internal organs. Many of the recorded cases of 'medullary' cancer of the jaw belong to this class.

3. Myeloid Sarcoma has long been recognised in relation with the jaws, in which situation it was originally described by Paget. It is found in connection with the alveolus, forming the so-called myeloid epulis, and also in the interior of the lower jaw. Occurring in children or young adults, the myeloid growth springs from the interior of the alveolus, and protrudes between the teeth, which may be displaced. The growth is softer than the fibrous epulis and more vascular, and occasionally presents characteristic dark spots beneath the mucous membrane; or, when developed deeply in the interior of the lower jaw, it expands the bone without forming an external protrusion. The development of cysts is not infrequent in the interior of the growth, which may pulsate. A section of the tumour shows the maroon colour resulting from hæmorrhages within the tissue, so common in myeloid growths. The question of recurrence, in connection with myeloid growths, is a very important one, and it may be considered that after complete removal recurrence does not take place.

4. Alveolar Sarcoma occasionally affects the jaws, and in the Museum of the Royal College of Surgeons of England will be found a specimen of the kind. This form of sarcoma was called by Wedl 'a fibrous form of cancer arising from bone,' and should undoubtedly include the cases hitherto described as examples of scirrhus of bone.

5. Fibro-sarcoma closely resembles fibroma in external appearance, and generally grows beneath the periosteum.

6. Chondro-sarcoma, in which spindle- or round-celled sarcoma is mixed with the cartilage forming the bulk of the tumour, occurs in both jaws, and frequently leads to secondary deposits in the lungs.

7. Ossifying Sarcoma, and Osteoid Chondro-sarcoma, imply the occurrence of ossification in tumours containing sarcomatous elements, and include the cases hitherto described as 'osteoid cancer.'

Carcinoma.—The only form of carcinoma affecting the jaws is epithelioma, which is found in at least two varieties, the squamous and the tubular. The position of these depends upon the nature of the normal epithelium of the part; thus, the squamous epithelioma is developed primarily in the mucous membrane of the palate and gums, the normal epithelium of which is squamous; whilst the tubular form with cylindrical epithelium begins in the antrum or nose, the epithelium of which is columnar. *See* Antrum, Diseases of the.

Both forms of epithelioma have a great tendency to invade surrounding parts, especially the bones, and hence the difficulty of completely extirpating the disease, except by proceedings of a magnitude which may not be justifiable in the weak condition of the patient.

Squamous Epithelioma of the palate and gums begins very insidiously, and its nature is therefore often mistaken at first. Commencing as a small, ragged ulcer on the mucous membrane of the gum, it is often, and probably correctly, attributed to the irritation of decayed teeth or fangs, or to secondary syphilis, but is regarded of little importance, or is perhaps irritated by the application of nitrate of silver or other irritants.

Ulceration of the palate of an epitheliomatous character is more frequently attributed to tertiary syphilis; and even large gaps in the hard palate, caused by epithelioma, are supposed to be the result of a broken-down gumma. But epithelioma of the gum or palate probably never occurs before the age of 40, and more often nearer 60 than 50, whereas the secondary manifestations of syphilis take place as a rule earlier in life, and the tertiary symptoms are much less urgent than those of epithelioma.

By involving the subjacent bone, necrosis is induced in the course of an epithelioma, and here again error may arise if the presence of bare bone be regarded as pathognomonic of necrosis, without considering the cause.

Tubular Epithelioma has been described by Reclus under the title of *epithéliome terebrant* (boring or burrowing epithelioma). *See* Antrum, Diseases of the.

The treatment of epithelioma of the jaws, like that in other parts of the body, consists in prompt and free removal of the affected part. When the disease is confined to the gum and margin of the alveolus, comparatively mild proceedings may be justifiable in the first instance; but if the disease has gone at all deeply, removal of the upper, or of a large portion of the lower, jaw should be undertaken without hesitation. Even then it may be impossible to clear away the whole of the disease, which may extend through the lower wall of the orbit, into the spheno-maxillary fossa, and up between the temporal and masseter muscles, and beneath the temporal aponeurosis.

Christopher Heath.

JAWS, Operations on the.—In all operations upon the jaws, the greatest care should be taken to avoid extensive scarring of the face and the infliction of unnecessary deformity, particularly by breaking the line of the lower jaw. Incisions for the relief of inflammation or the evacuation of matter, and punctures for emptying cysts or the antrum, should invariably be made within the mouth. Extraction of sequestra may be performed in most cases more conveniently through the mouth than by external incision, though the surgeon may occasionally avail himself of existing sinuses. The removal of epulis, in its varieties, can be readily accomplished through the mouth, if the operator is provided with proper bone-forceps of various kinds, and even large portions of the jaws may be thus removed with success. The late Mr. Maunder on two occasions removed large portions of the right side of the lower jaw, with the surrounding tumour, without any external incision, separating the soft parts with a raspatory, and sawing the bone in front of, and behind, the tumour. The principal difficulty in these operations was not so much the separation of the tumour as its 'delivery' through the mouth, which was slightly split in one instance. Fortunately, the hæmorrhage in both cases was slight, and the patients did well; but another surgeon was less fortunate, and lost his patient by secondary hæmorrhage, but, considering the close proximity of the facial artery, and the necessary division of the inferior dental artery, this is not to be wondered at. It may be doubted whether the extra trouble and risk of the proceeding are balanced by the absence of a scar, which, in the majority of cases, need not involve the lip, and, if properly placed, will be nearly invisible afterwards.

The same may be said of the so-called 'sub-periosteal resections' of the upper and lower jaws. In cases of necrosis it is, of course, advisable to preserve all the periosteum, and in extracting a sequestrum it may be occasionally necessary to turn aside soft parts with a raspatory; but any systematic stripping of the periosteum from a jaw involved in a tumour is not only impossible in most instances, but, if undertaken, will only leave shreds of periosteum, with possibly some portions of the disease.

Removal of the Upper Jaw, whether partial or complete, may be most conveniently performed as follows, the incisions being extended as the gravity of the case may indicate:—

A straight incision through the median line of the upper lip, and prolonged on one side of the columna nasi into the nostril of the affected side, will allow the tissues of the face to be readily dissected up off the jaw, so as to expose completely the front wall of the antrum. This may then be perforated, and removed with bone-forceps, so as to permit of the extraction of a tumour from within, or room may thus be found for the removal of large portions of the palate.

In a case of more extensive disease, in addition to the incision already made, one should be begun near the inner angle of the orbit, and be carried down by the side of the nose, and around the ala into the nostril. This will allow of further reflection of the soft tissues, and more complete exposure of the bone, so that it would be easy to cut away large portions of the jaw with suitable bone-forceps, or a small saw could be readily carried horizontally from the nostril at any level desirable, so as to preserve either the palatine or orbital plate. For removal of the entire upper jaw, it will be advisable to make an additional incision below the orbit from the inner angle to the malar bone, following the natural curve of the skin-markings of the part. This incision may be prolonged on to the malar bone as far as may be necessary, and may be met at its extremity by another at right angles to it, in very extensive disease of that bone. The flap of skin is now to be reflected outwards, and this method has the great advantage of preserving the facial nerve, and of dividing only small branches of the facial artery.

Division of the bone will be required at three points—(1) the palate, (2) the nasal process of the maxilla, and (3) the malar bone, and these sections may be made with the saw or bone-forceps, or more conveniently with both. A narrow saw, with movable back, is to be passed into the nostril, and the hard palate divided with the alveolus, from which a central incisor tooth should have been previously extracted.

The saw should be kept horizontal in the nostril, and there need be no fear of damaging the pharynx with its extremity. The movable back allows the blade of the saw to pass through the bone into the mouth, thus dividing the whole of the hard palate, without the splintering which usually follows division with bone-forceps. The soft palate escapes injury from the saw, and any attempt to dissect off and preserve the soft covering of the hard palate is futile.

The nasal process of the maxilla may be conveniently notched or completely divided with a small saw, which is next to be applied to the malar bone parallel to, and immediately in front of, the masseter muscle. This cut will then run into the spheno-maxillary fissure, and the prominence of the cheek will be preserved; but in cases of very extensive involvement of the malar bone, it will be necessary to remove the whole of it by dividing the zygomatic process, and the frontal process at its junction with the frontal bone.

Before dislocating the bone, it is well to divide the soft palate transversely close to its attachment to the hard palate, which can be readily done from the mouth.

With a pair of angular bone-forceps the three cuts made with the saw should then be thoroughly cleared, and it is convenient to take them in the reverse order, viz., malar bone, nasal process, palate. The bone-forceps, when dividing the palatine attachments, may be conveniently used to tilt the whole jaw forward, and the lion-forceps should then be employed to grasp it, and forcibly depress the mass, while the scalpel is used to divide the infra-orbital nerve behind the bone, so as to prevent its being stretched, and also any soft tissues which may remain attached to the jaw.

The hæmorrhage, which is often sharp for the moment, is best checked temporarily by thrusting a sponge into the opening, and this, after a few minutes' pause, may be withdrawn in order to allow of the application of the actual cautery at a black heat, so as to sear any bleeding vessel. A careful examination should be made to see that all the disease is removed, and the flap of skin is then to be replaced and fixed with fine wire sutures and hare-lip pins for the lip, the red margins of which are best approximated by a fine silk stitch.

Unless the oozing of blood is so considerable as to necessitate plugging the wound, it is better not to introduce any lint beneath the cheek, since it only collects discharge, and becomes very offensive in a few hours, when its withdrawal is both difficult and painful. Free syringing with antiseptic lotions from the first is useful, and for this nothing answers better than the continuous stream of the syphon nasal douche. *See* Nasal Douche.

Removal of the Lower Jaw.—In removing portions of the lower jaw, the incision should, as far as possible, be placed below its border, so that the cicatrix may be hidden.

An incision from the median line to the angle, thus placed, will divide the facial artery immediately in front of the masseter muscle, and both ends should be at once secured with a ligature. The tissues of the face can then be dissected up, and the cavity of the mouth opened by dividing the mucous membrane close to the gums, when any part of the body of the jaw can be removed by making a section, with the saw, on each side of it.

In making these sections, it is better not to complete one before the other is begun, because of the loss of resistance consequent upon breaking the continuity of the bone; but each cut being carried nearly through the bone with the saw, may be conveniently finished with the bone-forceps. Should it be necessary to prolong the incision beyond the median line, and to remove the symphysis, care must be taken to guard against the falling back of the tongue by having a stout thread passed through it, upon which traction may be made. The mylo-hyoid muscle and mucous membrane inside the bone can then be divided and the piece removed, but, whenever possible, the alveolus alone should be divided, and the lower border of the jaw be preserved.

For removal of one half of the lower jaw, it will be advisable to divide the lower lip in the median line; for though it is possible to perform the operation without this, yet, if the disease is at all serious, it unnecessarily complicates the operation to save the lip, which reunites readily enough. The incision should then be carried, at right angles to that in the lip, along the lower border of the bone as far as the angle, and then upwards to near the lobule of the ear. This will necessarily divide the facial artery, but no important branches of the facial nerve, unless prolonged into the parotid gland. The tissues of the face and of the masseter being dissected up off the bone or tumour, the jaw is to be divided at a convenient point, a tooth having been previously extracted. The scalpel is then to be carried closely along the inner surface of the jaw, to divide the tissues forming the floor of the mouth, and care must be taken not to detach or damage the sub-lingual gland.

The cut end of the jaw being grasped with the lion-forceps can now be everted, so as to bring the internal pterygoid muscle into view, and this must be dissected from the bone. Should the disease be of a non-malignant character, and not involve the articulation, the ramus of the jaw should be sawn across in preference to disarticulating; and, even when the tumour encroaches very closely upon the joint, it may be possible to divide the neck of the condyle and the coronoid process separately with bone-forceps.

In order to disarticulate the condyle, the soft tissues should be held out of the way with spatulas, and the jaw being firmly grasped with the lion-forceps, is to be depressed, so as to bring the coronoid process forward and allow of division of the insertion of the temporal muscle. This is sometimes rendered difficult by an unusual length of the process, or by its being jammed against the malar bone by the bulk of the tumour. In that case, it may be necessary to cut off the coronoid process with bone-forceps, or to break it by force.

The coronoid process having been cleared, the depression of the jaw from before backwards is to be continued, in order to throw the condyle forward; but great care must be taken not to rotate the jaw outwards, or the internal maxillary artery will be stretched around the neck of the bone, and be either torn or divided, when the hæmorrhage would be severe and difficult to arrest. The condyle being made prominent, the knife is to be carefully applied over it, when the bone will start forward, tearing through and bringing away with it a portion of the external pterygoid muscle. The knife must not be used to divide the muscular fibres, which bleed less if torn, but may be employed to divide the inferior dental nerve, so as to save it from being pulled out of the bony canal. When, from the nature of the tumour, the leverage of the jaw is lost, and consequently disarticulation of the condyle becomes difficult, recourse may be had with great advantage to the broad elevator recommended by Professor Gross for disarticulating the condyle from the glenoid cavity. In this way the bone may be forced from its socket, and the risk of hæmorrhage from the internal maxillary artery be completely avoided. Any bleeding vessels should be secured with ligatures, the lip united with hare-lip pins and the wound with sutures, care being taken to leave a dependent opening for the discharges. CHRISTOPHER HEATH.

JOINTS, Diseases of.—In considering the subject of joint-disease, it is well to bear in mind the structure and function of the part concerned; for it will be found, in practice, that in no class of diseases are these more intimately related to symptoms and treatment. Thus, the structures which usually enter into the formation of a joint are bone, cartilage, synovial membrane and ligament; surrounding the joint are muscles, with their corresponding vascular and nervous supplies, the arterial anastomoses being in most cases very free, and the nerves supplying the joint being derived from those that are distributed to the muscles which move it.

The *symptoms*, in any individual case of joint-disease, will vary in accordance with the particular structure which in that case is chiefly affected; and the determining of the part in which the disease originated, will often aid our diagnosis of the constitutional or other condition upon which it depends. So also in regard to function. The proper function of a joint is limited movement, which should be accomplished without pain or sensible friction. In disease, this function is disturbed in a manner which is indicative of the character and seat of the morbid process.

It will be observed that nearly all *acute* inflammations of joints commence as synovitis, although, if the process is not soon arrested, the other structures—cartilage, bone, ligaments—also become involved. These acute inflammations have their origin either in injury—as, for example, a sprain or wound—or in the constitutional diseases pyæmia and rheumatism, of which the joint-affection is but a part.

The *subacute* and *chronic* joint-diseases exhibit a much greater variety both in the tissues affected and in the mode of origin. These are either secondary to the more acute forms, of which a chronic traumatic synovitis is a common example; or they are due to divers constitutional conditions, of which the most frequent are scrofula, rheumatism, syphilis, gout, and some of the milder forms of septic infection. Very often too, an injury will be found to be the starting-point of a chronic joint-affection, the persistence of which depends upon constitutional disease.

It will be convenient to describe the diseases of joints, first in relation to the particular tissue which is chiefly affected; and secondly in relation to the associated constitutional condition.

DISEASES OF THE SYNOVIAL MEMBRANE. Of all the joint-structures, the synovial membrane is the most liable to the various forms of inflammatory disturbance. It is exceedingly sensitive to injury, and to any changes in the amount or character of its blood-supply.

In *Acute Synovitis* the synovial membrane rapidly becomes swollen and vascular, losing its natural smoothness, and presenting a velvet-like surface; at the same time the cavity of the joint becomes distended with an abundant secretion of slightly turbid synovia. Minute blood-vessels are seen traversing the membrane and giving it a brilliant red colour, with here and there patches of deeper tint, so that its encroachment upon the cartilages is rendered very obvious. Under the microscope, the synovial fluid is seen to contain leucocytes, oil-globules, and shreds of fibrinous material; the cellular element increasing in proportion to the severity of the inflammation, and the fluid approximating in varying degrees to the character of pus.

The *symptoms* are pain, heat, and swelling of the joint, together with pyrexia. The pain is of an aching and throbbing character, greatly aggravated by movement or interarticular pressure; the joint not only feels hot to the patient, but its temperature is actually raised; the swelling corresponds to the limits of the synovial sac, it obscures the natural outlines of the bones, and fluctuation can be felt across the joint. The muscles which act upon the joint are in a state of rigidity, and fix it, usually in the position of partial flexion. The pyrexia varies in proportion to the size of the affected joint and the acuteness of the process. There are often some premonitory rigors. The result may be either the complete subsidence of the inflammation, the joint being left for a time somewhat tender and loose from the stretching its tissues have undergone; or there may be partial subsidence into the condition of chronic inflammation; or suppuration may ensue.

The occurrence of *suppuration* is indicated by marked increase in the constitutional disturbance; rigors occur and may be repeated, the temperature rises, the pulse is quickened, and if the joint affected be a large one (e.g. the knee), the patient is gravely ill. There is not necessarily any increase in the amount of fluid in the joint, but the tissues around usually become œdematous, the skin red and hot, and the pain very severe, so that appetite and sleep are lost. Painful startings of the limb now occur, and any movement of the joint-surface is attended with severe suffering. The ligaments also become softened, so that, unless means are taken to prevent it, displacement of the bones takes place in the direction in which the muscles have most power.

If exit is not now given to the pus, it makes its way out of the joint into the surrounding tissues and then to the surface. As the suppuration progresses, the cartilages become ulcerated and detached, the bone-surfaces exposed and displaced, and the joint is thus irretrievably damaged; while at the same time the patient is in danger of pyæmia, hectic, and exhaustion, from which he is often only to be rescued by amputation of the limb.

Suppuration of a joint is not, however, necessarily attended with ulceration of the cartilages, though it usually is. Early incision and free drainage may be followed by recovery, with little or no impairment of movement. In the majority of cases, however, the most favourable result that can be obtained is a joint more or less fixed by adhesions, and weakened by softening and destruction of its ligaments; limitation of the natural movements by adhesions being often accompanied by too great mobility in other directions.

The *treatment* of acute synovitis in a healthy person should be antiphlogistic and decided, for it is of great importance to arrest the morbid process at the earliest possible stage. The maintenance of the joint in a condition of rest is the first essential; this must be attained by the application of suitable splints or other apparatus for ensuring immobility. *See* ANKLE, ELBOW, HIP, KNEE, SHOULDER, WRIST.

At the outset of the inflammation, leeching is of great value; ten leeches applied to a joint such as the knee, or six to the elbow, may cut short the attack at its commencement. Great pain is a special indication for leeching, which almost always gives relief. If the abstraction of blood is undesirable, cold should be applied to the joint by means of an ice-bag, Leiter's tubes, or evaporating lotions. In the beginning of traumatic synovitis, elastic pressure made with an india-rubber bandage, over which an ice-bag can be placed, is often very useful. In some cases, however, it will be found that warm fomentations are more comfortable and equally beneficial.

Besides such local measures, a purgative will generally be needed, and, if the constitutional disturbance be severe, opium should be given in small doses frequently repeated, to which, if the pulse be hard, a little tartar emetic (gr. $\frac{1}{10}$th to gr. $\frac{1}{6}$th) may be usefully added. If the distension of the joint is not thus diminished, it should be punctured with a fine trocar or aspirating-needle, and the distending fluid be withdrawn. Every possible care must be taken to prevent the entrance through the puncture of any septic material into the joint, and gentle elastic pressure should be maintained after the evacuation of the fluid. A convenient method of procedure is to encircle the joint with an elastic bandage, between two of the folds of which a small interval is left; in this interval the joint is punctured with a fine hollow needle attached to a syringe with a glass barrel, so that the nature of the fluid can be observed. The skin around the point of puncture is to be previously washed with a solution of carbolic acid (1 in 20), and the needle thoroughly cleansed in the same solution. The needle should be introduced obliquely, and the fluid gently and slowly withdrawn, the suction of the syringe being arrested as soon as the fluid ceases to flow readily, or if it become tinged with blood. On the needle being removed, the little wound is immediately closed with plaster.

Puncture of a distended joint, thus performed with strict antiseptic precautions, is a safe method of relieving tension, and the withdrawal of even a small quantity of the fluid is often followed by immediate subsidence of the inflammation and the gradual absorption of the remaining effusion. If, after the acute stage has passed, there still remain an excess of fluid in the joint, its removal will probably be obtained by the application of a blister, or by maintaining even pressure by means of an elastic bandage or frequently renewed strapping. After an attack of acute inflammation or distension, the tissues of a joint are left loose and softened; support should therefore be given, by strapping or bandaging, for some weeks after the use of the joint is recommenced.

If the inflammatory process passes on to the stage of suppuration, the gravity of both local and general conditions is greatly increased. The time for depletion is now passed, the patient's strength will require supporting rather than depressing, and our efforts must be directed to maintaining the best local and constitutional conditions for the repair of the damaged joint. If, then, the symptoms are such as have been described above as indicating suppuration of the joint, and especially if the patient's temperature remains persistently high, the character of the contained fluid must be ascertained by antiseptic puncture with the exploring syringe. Should the fluid withdrawn prove to be only turbid, and not actually purulent, its removal may be the first step towards recovery, and the avoidance of suppuration may still be hoped for. If, however, the fluid prove to be pus, its free evacuation is urgently needful. For this purpose the joint must be freely incised in such a situation as will best ensure complete drainage: its cavity must be syringed out with an antiseptic solution (e.g. 1 part of carbolic acid to 40 parts of water), and the wound dressed with absorbent antiseptic dressings.

The success of the treatment will depend very much upon the efficient drainage of every part of the joint-cavity, and upon the avoidance of septic infection. The strictest antiseptic precautions must be observed. The incision must be made, if possible, in the most dependent position, a drainage-tube must be inserted to ensure the patency of the wound, and, if the joint does not thoroughly empty itself, it must be daily washed out by gentle irrigation with carbolised water. A good form of dressing is a pad of carbolized wool enclosed in a double layer of eucalyptus or carbolized gauze, which should be changed sufficiently frequently to prevent the discharge soaking through or decomposing. The temperature should be carefully watched, and any sudden rise taken as an indication for an examination of the joint, to make sure that the route of exit for the matter is quite free.

The incision of a large joint is doubtless a very serious proceeding, but the detention of matter within the cavity of a joint is still more dangerous; and, if the precautions indicated above are observed, the operation is often followed by an immediate improvement in the general condition of the patient, and may even lead, in young subjects, to complete recovery of the functions of the joint; in the adult, however, ankylosis is the more common result.

Should the evacuation of matter not be followed by a satisfactory improvement, the question of amputation will have to be considered. The decision must be based upon a consideration of the reparative power of the patient, the severity of the constitutional irritation, and the probable usefulness of the limb if preserved. Age, habits, diathesis, and environment must all be taken into account, and of course each case must be decided on its own merits; but in general terms it may be said that amputation is called for when, in spite of free drainage of the joint, the suppuration does not diminish, and the patient is losing ground, and becoming worn out by pain and fever. When under such circumstances the source of irritation is removed by amputation, health is often recovered with surprising rapidity.

During the period of suppuration, the environment of the patient should be carefully looked to, for the progress of the case will be greatly influenced by hygienic precautions. A well-ventilated room, nourishing and easily-digested food, scrupulous cleanliness, protection of points of pressure against the formation of bedsores, the administration of suitable tonics (of which quinine is especially to be commended) and stimulants (which often act most usefully in promoting sleep as well as supporting the strength)—these, and the care of an efficient nurse, are the aids to recovery which are to be especially desired.

Sub-acute Synovitis is a distinction which it is convenient to maintain, both from the acute form which has been described above, and from that variety which is from its commencement characterised by indolence and chronicity. Every gradation is, in practice, met with between the most acute and the most chronic form of joint-inflammation; but there is a large number of cases in which the causes at work are the same as those which give rise to the acute disease, but which, operating less actively, produce effects similar in kind but less in degree.

This is the subacute group, which in no way resembles, either in its causation or in its local and constitutional concomitants, the chronic form to be subsequently described, but which has everything in common with the acute form excepting its virulence. An example of subacute synovitis would be that caused by a sprain in a healthy person. The injury is followed by a rapid effusion into the joint of nearly clear synovia, giving rise to a corresponding amount of swelling, tension, heat, and pain. Movement of the joint is restricted and painful. There is slight constitutional disturbance, the temperature reaching, perhaps, 100°. If the part be kept at rest, the symptoms soon subside. There is but little tendency to suppuration, the health is unaffected, and in a few weeks the joint is restored to partial or complete activity.

The *treatment* of this class of cases must be regulated in accordance with the degree of activity to which the inflammatory process attains. At their commencement, severe or increasing pain may usually be taken as an indication for leeching; but the majority of the subacute inflammations of joints are to be arrested by the application of cold and pressure, and the maintenance of rest. After the subsidence of the early symptoms, there very commonly remains more or less excess of synovial fluid in the joint, and for this repeated blisters should be used, followed by elastic pressure or the application of strapping.

It is often necessary to maintain some form of pressure upon the joint for several months, in consequence of the tendency to re accumulation of fluid within the joint which these cases exhibit. Should this passive form of effusion recur without fresh inflammatory symptoms, the application of what is usually known as a 'Scott's dressing' will be found very useful. This is a combination of pressure with mercurial inunction. The joint is to be enveloped in strips of lint, on which is spread the camphorated mercurial ointment; over this several layers of firm adhesive plaster are to be strapped, so as to make even pressure on all parts of the joint, to restrict its movement and to give support; outside all a gummed bandage is to be placed. It is to be borne in mind that an essential part of this method is the use of even pressure, so that the joint must be restrapped every few days, or as often as the plaster becomes loose. In some instances, this passive effusion is persistent in spite of such treatment, or recurs immediately that the joint is released from pressure. This condition, found chiefly in the knee, is called *hydrops articuli*. For this the removal of the fluid by aspiration, followed by the use of a Scott's bandage, should first be tried. If this fails, the joint is to be injected with a mild aseptic stimulant. A 1 per cent. solution of carbolic acid in water may be injected by a fine syringe into the previously emptied joint ; the solution, having been brought into contact with every part of the synovial cavity, is then withdrawn, and finally the joint is covered with a layer of cotton wool half an inch thick, which is bandaged over it so as to maintain moderate pressure and yet allow of some swelling. *See* HYDRARTHROSIS.

The result of the injection will probably be some slight inflammation and swelling, which on its subsidence leaves the synovial membrane in a condition less prone to excessive secretion. The joint must be kept at rest during this treatment, and, should any acute symptoms arise from the injection, they must at once be combated by the use of cold or other antiphlogistic measures. Should the mild solution recommended not suffice, a stronger must be used, or a mixture of tincture of iodine and water (1 in 10) may be substituted.

Many cases of subacute synovitis are kept up by the presence of adhesions within the affected joint. This cause may be suspected when a joint, which has previously been more acutely inflamed, is liable to frequently recurring attacks of pain and swelling, provoked by any unusual exercise or freedom of movement. On examining such a joint, pain will be evoked whenever the limb is moved in some particular direction, in which also movement will be found to be unnaturally restricted; very often a painful spot can be exactly indicated by the patient. In these cases the synovitis is kept up by the stretching of the adhesion, and may be promptly brought to an end by the forcible rupture of the adhesion, which must be done by a sudden and unexpected movement, so that the muscular resistance is evaded by surprise ; or else while the patient is under the influence of an anæsthetic. *See* BONE-SETTING.

Chronic Synovitis is the most common of joint-affections, and will often be found to be associated with some morbid diathesis, such as scrofula or rheumatism. Yet there are many cases—especially in children—in which the joint-affection is the only sign of disease, and which are, without doubt, of local origin. These are mostly due either to neglect of the original injury, so that the joint is not given a fair chance of recovery—a condition often met with among the children of the poor owing to their domestic difficulties; or they arise from repeated injuries to a damaged joint—a not uncommon occurrence, because a joint once weakened by inflammation is all the more prone to subsequent accidents.

But the very persistence or chronicity of a synovitis, unless it be thus accounted for, should lead us to suspect some constitutional error, the discovery of which may be essential to the effectual treatment of the disease. Chronic inflammation of the synovial membrane may be the result of the subsidence of the acuter forms, in which the membrane, instead of recovering its normal condition, remains somewhat swollen and vascular, and secretes an excess of synovial fluid; or the process may be, from the commencement, of a slow and indolent kind. The joint is observed to be swollen, partly from fluid in its cavity, and partly from thickening of the synovial membrane; it is slightly hotter than the corresponding joint of the opposite side, and is moved a little less freely. There is tenderness, often of limited area, and confined to one or two spots. Pain is trifling, and perhaps only elicited upon extreme flexion or extension. If the affected joint be of the lower extremity, there is more or less lameness, chiefly owing to the involuntary restriction of the natural movements.

As the disease progresses, the synovial membrane becomes gradually more thickened and pulpy, the bony outlines of the joint are concealed by a general elastic swelling, giving to the touch a deceptive sense of fluctuation; the ligaments soften, the bone-surfaces become displaced, and the functions of the joint are slowly but surely lost; at the same time the related muscles undergo proportionate wasting. If the interior of such a joint is examined, it will be found that the synovial membrane presents morbid changes of much greater extent and degree than the other joint-structures. The ligaments may be softened and stretched, and the cartilages eroded here and there, but the bones remain unaltered. The delicate synovial membrane of health is replaced by a thick, semi-opaque, gelatinous mass, which is adherent to the cartilages, and bulges into all the less resistant parts of the joint.

In some few instances, the thickened membrane develops a fringe of pendulous growths, which project into the cavity of the joint; these may become elongated sufficiently to allow of their free movement within the joint, or may become entirely detached, and so give rise to the symptoms of LOOSE CARTILAGE. But more usually the growth affects uniformly the whole of the synovial membrane; it may attain the thickness of a quarter or half an inch; it is of yellowish-brown colour, intersected with white streaks and a few small blood-vessels; its consistency varies from that of friable granulation-tissue easily breaking down under the finger, to a toughness almost approaching that of fibro-cartilage. Microscopic sections of this material show it to consist of a delicate fibrillated stroma, containing in its meshes free nuclei and nucleated cells of varying size and shape, but mostly of somewhat oval outline.

This stage of the disease may last a long time—months, or even years—giving rise to but little pain, and causing but slight inconvenience beyond the weakness and diminished mobility of the affected joint; but nevertheless, when the synovial membrane has once undergone pronounced gelatiniform degeneration, the condition is one which does not admit of the restoration of the integrity of the joint. Usually, indeed, the disease is slowly progressive. In advanced cases, numerous points of fatty degeneration and of suppuration may be seen in the thickened synovial tissue, and sometimes its entire free surface is covered with a distinct layer of pus-secreting granulation-tissue.

When suppuration occurs within the substance of the pulpy membrane, matter may make its way either to the surface or into the interior of the joint. If it come to the surface, a localised swelling forms over some part of the joint; if this be not opened the skin slowly ulcerates, ill-formed flocculent pus escapes, and an indolent sinus remains. If, on the other hand, the progress of the matter is into the interior of the joint, a chronic suppuration of the joint ensues, which gradually leads to its complete disintegration. But suppuration of a joint, thus altered by previous chronic inflammation, differs entirely, both in its gravity and its symptoms, from the acute form which has been described above. There is usually some little increase of pain and swelling, and the temperature rises at night; but in many cases the symptoms are but little aggravated, and the destruction of the joint is indicated more by the increasing displacement and ligamentous softening than by any marked constitutional disturbance.

The *treatment* of the earlier stages of chronic synovitis resolves itself chiefly into securing the immobility of the joint, and the use of some form of counter-irritation. At the same time the constitutional condition of the patient should be carefully regarded, any morbid tendencies as far as possible counteracted, and the reparative powers assisted and maintained. As the joint must be kept at rest for a considerable period, it is important to arrange this without confining the patient to the house. In the upper extremity this is easy; but when the joints of the lower limb are affected, some ingenuity is necessary to allow of locomotion without harmful joint-movement. In the majority of cases, it will be found that a well-moulded leather splint is by far the most comfortable apparatus for maintaining immobility. A cast of the limb should be taken, and the leather moulded thereon. The splint should extend sufficiently far, above and below the affected joint, to keep the muscles which act upon the joint in complete rest; it should be made to lace, so that it can be easily removed and reapplied; and great care should be taken to avoid undue pressure upon all bony prominences. Plaster of Paris, paraffin, and similar kinds of splints have the great disadvantage that they do not allow of the inspection and cleansing of the skin, so easily permitted by the laced leather splint. Most of the felt and other plastic materials invented for the purpose have the defect of becoming softened by the heat of the body, and thus soon losing their efficiency. Gutta-percha is worse than useless.

In the upper limb, in addition to the splint, the arm should be carried in a sling.

In the lower limb, the affected joint being fixed by a splint, the patient may move about with the aid of crutches, the boot of the sound limb being sufficiently raised, by adding to the sole, to keep the diseased limb off the ground; or, if the tarsus be affected, the weight may be borne upon a knee-rest with a wooden leg. A Thomas's splint—i.e. a metal band moulded to the back of the limb, with cross-grips to keep it in position—is also very useful for the hip or knee.

If the synovial thickening be only slight, great benefit will be obtained by the light application over the joint of the actual cautery, repeated at intervals of about a week; or by the use of small and frequently repeated blisters, after which the joint should be strapped in camphorated mercurial ointment. Sulphur ointment, rubbed into the joint and applied beneath a flannel bandage, is also useful; and as recovery is approached, friction, the warm douche, and passive movement may be added with advantage. If, however, the synovial disease has advanced to the stage of pulpy degeneration, a cure must not be expected. The intractable nature of this form of joint-disease has long been recognised, and the accuracy of Sir Benjamin Brodie's statement that in its advanced stage it does not admit of cure, still remains undisputed. It is true that a long perseverance in treatment of the kind indicated above—i.e. rest and counter-irritation—may succeed in reducing the joint to a condition which is tolerable to a person in good circumstances. A splint being worn, and the limb but gently used, the joint may remain in a lamed but painless and quiescent condition for many years. But to those for whom an active or laborious life is a necessity, or whose means do not allow of a long period of idleness, some more radical treatment is needful. In the upper extremity, and especially when the elbow is the joint affected, excision offers a very satisfactory prospect; and indeed the condition is one to which this operation is particularly applicable. In the lower extremity we have a choice of several methods of treatment.

In children and young persons an attempt may be made to dissolve away the morbid synovial growth. For this purpose, a solution of sulphuric acid (one part of acid to two parts of water) has been freely applied to the interior of the joint by means of strips of lint soaked in the solution and introduced through free incisions. More or less ankylosis usually results, but in some instances very useful movement has remained. Iodoform has also been injected into the thickened membrane, and in some cases with decided benefit; its action appears, however, to be somewhat uncertain. Another plan is to open the joint and scrape away, with a Volkmann's spoon, as much as possible of the diseased membrane and granulation-tissue.

If there is much displacement of the bones, and the health and age of the patient are such as to warrant the expectation of sufficient reparative power, excision will be the appropriate treatment. In these cases of synovial disease it suffices to remove a very thin slice of bone, the aim being the removal of the pulpy synovial tissue, and just so much of the articular surfaces of the bones as to enable ankylosis to take place in a favourable position of the limb. When abscess has occurred, and the joint has suppurated, the same treatment will be necessary. In the upper classes to whom time and expense is of less consequence, the evacuation of matter, the cleansing of the cavity of the abscess or of the suppurating joint with antiseptic dressings, and careful support of the reparative powers, will in most cases lead at last to the desired ankylosis; so that excision or amputation are but rarely called for. But amongst the poor, who cannot afford either the time or the other aids needful to this end, it is best to rid them of their disease at once by excision or amputation. Amputation is indeed sometimes urgently necessary on account of the drain upon the health caused by the suppurating joint; and it must be remembered that excision is much the more severe operation of the two, and requires for its successful issue a much greater amount of endurance and reparative power.

Diseases of the Articular Cartilage. It has been frequently asserted that there is no such thing as primary disease of the articular cartilage, and it is certainly true that disease of this structure is generally secondary to affections of the joint-ends of the bones or of the synovial membrane. Yet there is good reason to think that the changes associated with the disease known as 'chronic rheumatoid arthritis,' or 'osteo-arthritis,' have their origin in a low form of inflammation or degeneration of the articular cartilage. *See* Osteo-Arthritis. There are, moreover, certain cases to be met with, wherein the ulceration of the cartilage occurs at an early stage of the joint affection, and in which the symptoms depending upon this ulceration and the consequent exposure and inflammation of the articular lamella of the bone are notably predominant.

Such cases are characterised by the early occurrence of extremely painful startings of the limb, and by the slight degree of accompanying swelling and constitutional disturbance. In this form of joint-disease the limb is very soon disabled for use, because of the extreme painfulness of any movement of the joint surfaces; and a distressing feature of such cases is the disturbance of rest by the muscular spasm, which is apt to occur just at the commencement of sleep, and which brings into acutely painful contact the sensitive bone-surfaces where exposed by the removal of the cartilage. This is especially the case in disease of the hip-joint, and gives rise to the characteristic 'night scream' of children thus affected. This symptom depends, not upon the mere inflammation of the cartilage (which there is good reason to believe is not a particularly painful process), but upon the inflammation and exposure of the articular lamella of the bone; and the occurrence of this symptom, during the progress of any case of joint-disease, may be taken as highly significant of the destructive process having reached the stage of ulceration of the cartilage and exposure of the bone.

Articular cartilage, which is undergoing inflammation and ulceration, exhibits to the naked eye changes both of colour and texture. Instead of the pearly blue colour and perfect smoothness of health, there will be seen patches and lines of a yellow tint. The surface is sometimes roughened and fibrous, sometimes marked with little pits, giving it a worm-eaten appearance. In some parts the cartilage is seen to be eroded, thinned, softened, or entirely removed; it is easily separable from the bone, or may have become detached in pieces of considerable size. Microscopic examination shows the process to consist of an increase in the size and number of the nuclei of the cartilage-cells, and absorption of the hyaline intercellular material. This leads to rupture of the cell-wall and escape of the nuclei which have undergone granular degeneration, and thus to loss of substance or ulceration. In more chronic cases, the cartilage is found to have undergone fibrillation rather than ulceration: or its destruction may be due to encroachment upon its attached surface by granulations springing from the bone beneath. If the disease is arrested before any considerable destruction of the cartilage has occurred, the surface may heal by the formation of fibrous tissue, which may merely fill up the gap, or may form an adhesion to a corresponding spot upon the opposite surface of the joint. If the cartilage be extensively removed, either the joint will be destroyed by suppuration or, the destructive process coming to an end, there will be an effort at repair, and the opposed bone-surfaces will become firmly adherent by fibrous or osseous ankylosis.

In the *treatment* of this variety of joint-disease, counter-irritation, especially by the actual cautery, will be found of great efficacy. Rest, by extension or suitable splints, is also of course essential, and may be much aided by the internal administration of opium, or the subcutaneous injection of morphia. Tenotomy of muscles, the contraction of which is producing inter-articular pressure, is also sometimes useful.

Disease of the Articular End of a Bone.—A great number of cases of joint-disease have their origin in inflammation of the adjacent bone. This may be acute or chronic.

In acute periostitis and osteo-myelitis, the inflammation may spread to the joint-end of the bone and thence to the joint, terminating often in acute suppuration. But, if the disease begin in the shaft of the bone, it is often limited by the epiphysial cartilage, and thus, though the joint may be somewhat disturbed by the contiguity of the inflammation and show signs of effusion within its cavity, it may yet escape the destructive suppuration which has attacked the adjacent bone.

Acute inflammation may, however, commence in the epiphysis, and when this occurs the joint is almost certain to become involved. This is a disease chiefly of early infancy; it has been described by Mr. Thomas Smith as 'acute arthritis of infants,' and of 22 cases related by him, 8 occurred in infants under a month old, 4 in infants under two months, 7 between the ages of two months and six months, and 3 in children between six months and one year old. The disease is an acute one, and runs a rapid course, usually to destruction of the joint and death, often by pyæmia, but sometimes to recovery, with a shortened limb and weakened joint.

The first *symptom* is usually impaired movement: the child keeps the limb fixed in a position of partial flexion, and gives evidence of pain on any attempt at movement of the joint. The pain rapidly increases, the joint becomes hot and swollen, and the child is very ill; suppuration rapidly ensues, and the abscess bursting or being opened, either death soon follows, or the discharge quickly diminishes, healing takes place, and the child is left with a more or less crippled but often very useful limb. Ankylosis rarely results in this form of joint-disease.

The suppuration occurs, in many of these cases, in the centre of the epiphysis, the matter making its way into the joint by a small sinus; or it may begin just beneath the articular lamella; or the joint-surface of the epiphysis may be first attacked, and destruction and separation of the whole or part of the epiphysis rapidly ensue. Several joints may be simultaneously or consecutively affected, but this is not incompatible with recovery. *See* Epiphyses, Affections of.

The *treatment* of this disease consists of early evacuation of matter, careful feeding and support of the child's reparative powers, and the maintenance of rest in the joint. This last is often best attained, in these young infants, by surrounding the limb with a soft pillow or junk, rather than by the application of the ordinary splints.

Chronic Articular Ostitis is a much more common affection than the acute form described above. Although frequently met with in children, it prevails at a somewhat later age than the acute disease. The result of chronic inflammation of the cancellous tissue of the expanded joint-end of a bone is, very often, the formation of a circumscribed central slough. A limited portion of the cancellous tissue in the centre of the bone dies, suppuration occurs around it, and the result is a circumscribed abscess, in the centre of which is either a defined fragment of necrosed bone, or a small round mass of softened carious bone, separated by a perfectly-defined line from the surrounding healthy tissue, from which it can be easily turned out. Usually the matter at last makes its way into the neighbouring joint, but occasionally the inflammatory products undergo caseous degeneration and remain enclosed in the surrounding bone, as circumscribed yellow masses, which have been sometimes described as 'crude tubercle.' In other cases, however, the process leads to ulceration of the bone, either upon the surface of, or just beneath the articular lamella, and thus to the earlier implication of the joint.

The *symptoms* of chronic articular ostitis are, as a rule, very slowly and gradually developed. A dull aching, in one of the bone-ends entering into the formation of a joint, may persist for many weeks or months before any other signs are manifest. Then comes slight restriction of joint-movement, and some tenderness on pressure. Later still a little swelling may be detected, and this is chiefly a thickening of the periosteum and other structures immediately over the bone, so that the natural outlines and prominences are less easily felt and seen than on the corresponding healthy bone of the opposite limb. The swelling is but slight, and is often irregular—that is to say, more marked on one side of the bone, or there may be a circumscribed and painful swelling at one spot.

A careful examination will often detect some small area, over which deep firm pressure will always produce pain. At last there usually appear signs of implication of the joint; swelling, due to fluid effusion into the synovial cavity; starting pain and muscular spasm; peri-articular œdema and increased local heat. At the same time the temperature of the body rises, and there are other signs of constitutional disturbance, such as rigors, loss of appetite, and impaired sleep. The earlier the joint-implication the more severe are its symptoms. When the disease has been of long duration before it penetrates to the joint, its progress is usually accompanied by chronic synovial thickening, and in such cases the commencement of suppuration of the joint is not necessarily manifested by any very marked increase of the symptoms. Matter may slowly make its way along the epiphysial junction to the surface, or burrow along the tendons and intermuscular planes, and point at a considerable distance from the joint. Sinuses are thus formed, which have the prominent granulations at their orifices significant of their leading to diseased bone.

Treatment.—It has been the fashion to speak of this type of joint-disease as 'scrofulous,' and there can be no doubt that many cases occurring in children are associated with other marks of the scrofulous diathesis. But certainly the majority have no such connection, and are met with in persons otherwise quite healthy; a large number of these may be traced to a traumatic origin. No reminiscences, therefore, of the name 'scrofulous' should deter the surgeon from adopting antiphlogistic treatment at the commencement of the disease.

Deep-seated pain in a joint-end, such as is significant of commencing articular ostitis, is often immediately and permanently relieved by the application of a few leeches, or of the actual cautery; and there is no reason to doubt that the disease has often been thus arrested at its outset. The joint must be kept at rest by means of splints; and a gentle course of biniodide of mercury is certainly frequently beneficial. Later on, if pain is persistent in one spot, and especially if there be deep-seated tenderness, an attempt should be made to reach the inflamed area by incision of the bone. Even if suppuration may not have occurred, this measure will probably be followed by relief. If the painful spot is accessible without interference with the joint, it should be cut down upon and its surface carefully examined for any evidence of disease. Sometimes the opening of a minute sinus may be found leading into the suppurating cavity, or the periosteum may be raised by a little inflammatory effusion, or the bone surface may be altered in colour; any such indications as these should, of course, be followed with regard to the direction in which the bone should be perforated; should no change be discoverable on the surface, the locality of the pain must be taken as the guide.

If the reflexions of the synovial membrane have such a relation to the seat of pain, as to prevent the possibility of cutting down directly upon it without opening the joint, the inflamed part must be reached indirectly by perforating the bone at the nearest accessible spot outside the limits of the joint. If the bone is hard, it is best opened with a small trephine; if soft, a gouge or a narrow chisel may be conveniently used; for exploratory purposes a carpenter's bradawl will be found a useful instrument. If a spot of central caries or necrosis is found, the diseased or dead bone should be removed, as well as the granulation-tissue which surrounds it. If an abscess be opened, its wall should be scraped, and the cavity and any sinus leading to it should be sponged out with a solution of chloride of zinc (40 grains to the ounce). If the necrosis be of the joint-surface, it is still sometimes possible to remove the sequestrum and leave a comparatively useful joint. If the synovial membrane have undergone much thickening, and there is extensive caries of the articular lamella, excision or the treatment by sulphuric acid, described above, will probably be indicated, if the patient be still in childhood or youth. In those past this period of life amputation will generally be the safer treatment.

When the bones of the carpus or tarsus are the seat of destructive inflammation, and the disease is limited to one or two bones, excision of the affected bone or bones is often attended with excellent results. This is especially the case in the foot, wherein the disease is very often confined to the calcaneum or astragalus.

Diseases of the Ligaments. — The ligaments are seldom the seat of primary disease, and, from their resistant qualities and somewhat passive function, are usually amongst the last of the joint-structures to yield to the destructive influence of surrounding inflammation.

When, in consequence of an acute synovial distension, the ligaments are considerably stretched, their nutrition is so far interfered with that they undergo an amount of softening which leaves the joint weak and loose, long after the fluid has been absorbed. So also after sprains, the ligaments which have been stretched or torn are softened by the resulting inflammation. In such conditions it is wise, therefore, to support the joint by accurately moulded splints, by strapping, or by bandages. A well-made and softly padded leather splint is the most efficient support, and this should be removed daily for the application of a cold douche to the joint.

In chronic joint-diseases, when the interior of the joint is filled with granulation-tissue, this material surrounds and invades the ligaments, creeping in between and separating their fibres, and leading to their softening, degeneration, and eventual destruction. The result of this is that the bones become displaced in whatever direction the action of the muscles is predominant. This tendency to displacement must therefore be anticipated and provided against, in all cases of long-continued joint-disease, by the use of proper splints.

In rickets and other forms of debility the ligaments share in the weakness of the locomotive apparatus, which manifests itself in the occurrence of flat-foot, splayed-foot, knock-knee, lateral curvature of the spine, and other such distortions. The muscles failing in their weakness to hold the joints in position with firmness, undue stress is thrown upon the ligaments, the stretching of which gives rise to the aching pain which so commonly accompanies these affections, and which is sometimes mistaken for rheumatism.

PYÆMIC JOINT-DISEASE.—The affection of the joints most often met with in acute pyæmia is a rapidly progressive suppurative synovitis. The process is one of extreme acuteness and virulence; in no other form of joint-inflammation are the tissues involved so quickly destroyed. The joint may be found full of pus, and the cartilages extensively ulcerated, within forty-eight hours of the first sign of inflammation. The earliest symptom is usually swelling, which rapidly increases, and is soon followed by pain and heat. At this stage the synovial membrane is swollen and vascular, and the joint is filled with slightly turbid fluid. Soon the tissues around become œdematous, suppuration occurs, the cartilages ulcerate, and the joint is quickly disorganised.

Early aspiration should therefore be made; and, if the fluid be purulent, an incision must be made into the joint in such a position as will best ensure free drainage, the synovial cavity washed out with a mild antiseptic solution (e.g. carbolic acid in water, 1 to 80), and a drainage-tube left in the wound. It is of great importance to give exit to the matter at the earliest possible moment. As ankylosis is to be anticipated, every precaution must be taken to maintain the joint in the most useful position.

Besides this acute disease, there is also met with in association with the less virulent type of pyæmia, a more chronic and much less grave affection of the joint. This is characterised by a painful swelling of the joint, which rapidly attains its maximum, and which is attended with but little of the heat and tension that accompany the acute form. There is a milder degree of constitutional disturbance, and much less tendency to suppuration. In these cases several joints are often affected, the effusion subsiding in one as it appears in another, and gradually becoming of a less active character. Every degree is met with between the mildest form, in which there is an almost passive synovial effusion lasting only for a few days, and the severe and acute type above described. Among the diseases giving rise to the more chronic form of septic synovitis may be mentioned scarlatina, typhoid fever, gonorrhœa, and vaginitis. In these the effusion is generally not purulent, though often resulting in stiffness and adhesions, both intra- and extra-articular. Nevertheless, sometimes these same diseases give rise to the acutest form of the malady.

The local *treatment* will be the same as for ordinary synovitis, with the addition of whatever measures are needful to get rid of the source of the infection. Of medicines, quinine and sulphite of soda are the most useful; and, as in other septic diseases, a supporting plan of treatment is indicated.

RHEUMATIC SYNOVITIS may be acute or chronic. In the acute form it accompanies the characteristic fever, sweating, and other symptoms of rheumatism; it attacks chiefly the larger joints, and subsides with the diminution of the pyrexia. Not infrequently, however, in spite of the subsidence of the general disease, effusion and pain persist in one joint, and at this stage the case often comes under the treatment of the surgeon. Moreover, persons of rheumatic diathesis are liable to recurring synovitis of a subacute or chronic type, which has an obvious relation to their constitutional condition. These cases do not tend to suppuration, but very commonly lead to adhesions. In the acute form, rest, even pressure by cotton wool applied beneath an elastic bandage, or warm alkaline and opiate fomentations, are the appropriate local applications; in the chronic form, blisters, stimulant liniments, warm douches, and frictions.

The rheumatic tendency must also of course be treated (as by salicylates, alkalies, opium, and appropriate diet). In the later and chronic stage, 'rheumatic joints' are much benefited by Turkish baths, shampooing, and a residence in a dry, warm climate. *See* GONORRHŒAL RHEUMATISM.

CHRONIC RHEUMATIC ARTHRITIS, *see* under that heading and also OSTEO-ARTHRITIS.

GOUTY ARTHRITIS is an acute form of joint-inflammation characterised by extreme pain, rapid swelling both in and around the joint, œdema and redness of the skin, local heat, and a variable amount of pyrexia. It affects the smaller joints, especially the metatarso-phalangeal joint of the great toe, giving rise to deposits of urate of soda in the cartilages, ligaments, and adjoining structures. It occurs in persons of the uric acid diathesis, comes on usually after middle life, and is often inherited. Although gout is considered a medical rather than a surgical disease, and comes under the treatment of the physician, the surgeon will observe that many traumatic and other joint-affections, when they occur in persons of gouty habit, are considerably modified thereby; especially in the direction of chronicity and the deposit of urate of soda, with corresponding deformity and stiffness. The recovery of such cases will be aided by attention to the condition of the urine, and the judicious use of alkalies, colchicum, abstinence, and other remedies appropriate to the gouty state.

SYPHILITIC DISEASE OF JOINTS.—A not uncommon concomitant of the earlier secondary symptoms of syphilis is a transient synovial swelling, attended with aching pain and some heat in the part. The joint should be kept at rest while the swelling persists; under appropriate anti-syphilitic treatment recovery is usually complete.

A much more troublesome affection of the joints is that which occurs in the late stages of syphilis, and which consists in a gummatous infiltration of the synovial membrane or other joint-structures. This form of disease is of an indolent and persistent character. There is dull aching pain, often increasing at night, and there is irregular pulpy swelling, sometimes of the synovial membrane, sometimes of the soft tissues outside the joint, sometimes of the periosteum at the lower end of the bone. These growths may develop into fibrous thickenings and adhesions, or they may break down and ulcerate on to the surface or into the joint.

For *treatment*, the joint should be fixed by a splint, and full doses of iodide of potassium given, combined with tonics. The success of the treatment will depend much on the state of the patient's health; the condition is often met with in debilitated persons who will require the aid of good food, fresh air, and cod-liver oil. When the health has improved, much benefit is to be obtained from a mild course of mercury, especially the biniodide. Locally, the joint should be kept warm, but not otherwise stimulated.

A similar affection is sometimes met with in children about the age of puberty, who are the subjects of inherited syphilis. Infants suffering from inherited syphilis are liable to an epiphysial disease, which consists in an inflammation of the ossifying layer, giving rise to a separation of this layer, with the epiphysis, from the shaft of the bone. Several bones are usually attacked. *See* EPIPHYSES, Affections of.

The *symptoms* are a pseudo-paralysis of the affected limbs, and swellings at the position corresponding with the epiphysial line of some of the bones, most often the femur or humerus: later on, the epiphysis is felt loosened from the shaft, and there is probably fluid swelling around the end of the bone. There is an absence of any acute pain or marked pyrexia. The history, and usually some other symptoms, will be found to indicate the inheritance of syphilis.

If not very advanced the disease yields rapidly to mercurial treatment.

SCROFULOUS JOINT-DISEASE.—Scrofulous children are in a more than ordinary degree liable to chronic affections of the bones and joints. These affections have often a traumatic origin, but, occurring in scrofulous subjects, they exhibit a pertinacity and a tendency to degenerative changes less often met with in the healthy. But it must be remembered that there are other causes besides scrofula for the persistence of joint-diseases in children; as for example, lack of care, repeated injuries, and the physiological activity of the part; so that it is both inaccurate and confusing to apply the epithet 'scrofulous' to chronic joint-diseases unless they occur in connection with other signs of the scrofulous constitution. If, however, an indolent joint-inflammation is met with in combination with other symptoms of scrofula (e.g. glandular enlargements, chronic pulmonary, nasal, or intestinal catarrh, ophthalmia, persistent dermatitis), it is reasonable to assume that the joint-disease is of scrofulous origin. The most common forms of scrofulous joint-disease are chronic articular ostitis and pulpy degeneration of the synovial membrane (described above).

Either of these conditions occurring in a scrofulous subject is characterised by the extreme slowness and indolence of the process, and by the tendency of the inflammatory products to undergo retrogressive rather than developmental changes. Thus, in the bones the inflammatory cell-growth goes on very slowly, and is apt to lead to caseation and softening. So also the thickened synovial membrane shows much more tendency to fatty degeneration and suppuration than to fibrillation and cicatrization. Another marked peculiarity of scrofulous inflammations is the slightness of the pain and the small amount of pyrexia which accompany them. So that these scrofulous joint-diseases go slowly on for months and years; indolently, and often almost painlessly, progressing from slight and sometimes imperceptible beginnings, through gradually increasing swelling and softening of synovial membrane or joint-end of the bone, to ulceration of cartilages and yielding ligaments, displacement of the bones, and degradation of inflammatory products into ill-formed pus, and thus at last to destruction or permanent crippling of the joint. Yet if the child's health can be tended and improved, and if unlimited time can be given, many of these diseases at last come to an end. For scrofula is a disease of early life; it tends to wear itself out, and under improved hygienic conditions and appropriate remedies to disappear as the child gets older, though of course its effects may remain through life. Hunter said truly, 'Puberty often produces a cure.'

In the *treatment* of scrofulous joint-disease, therefore, the environment of the patient is of the greatest consequence, and every possible aid should be given towards improving the condition of nutrition and health. Long residence at elevated situations in bracing mountain air, or at the sea-side, is especially to be desired; and, when this cannot be obtained, as much as possible of sunlight and fresh air. Plenty of nourishing food, especially fatty foods, warm clothing, careful attention to the state of the digestive organs, early hours—all these are material aids in the treatment; of medicines, cod-liver oil and iodine are of the greatest value.

The local treatment must be in great measure determined by the general condition. As long as the health is improving, it is worth while to practise much perseverance in the management of the joint. A splint must be applied to maintain rest, and in the early stages counter-irritation by light touches of the actual cautery is of great use. If the synovial membrane is the seat of the disease, counter-irritation is to be followed by strapping over mercurial ointment, or some of the other measures described above (*see* above—section on *Chronic Synovitis*). If the bone is affected, regard must be had to any signs of central suppuration, calling for perforation or removal of sequestra. Even excision may often be permissible and successful after the health has been improved. But, if the general state of the patient is becoming deteriorated by the irritation of the local disease, amputation will probably be the wiser measure, for removal of the diseased limb is frequently followed by rapid recovery of the health.

Tabetic Arthropathy.—M. Charcot has called attention to a form of joint-disease occurring in connection with locomotor ataxy, which he considers to be peculiar to that disease. The first symptom is usually a sudden effusion of fluid within the joint, without pain or fever. This may gradually become absorbed, but after a time recurs, and is followed by rapidly progressive degenerative changes in the cartilages and bones, which give rise to great alterations of shape, to crepitation, and to displacement of the joint-surfaces. An examination of such joints shows the bone-tissue to be rarified, the Haversian canals widened, and the fatty elements largely increased; the joint-surfaces greatly worn away, and the ligaments softened and stretched. The knee is most often affected, but similar changes have been found in the hip, shoulder, wrist, and tarsus. It will be observed that this affection closely resembles chronic rheumatoid arthritis, from which the chief anatomical distinction is said to be that there is less formation of new bone and greater destruction of the articular sufaces. It is indeed, by some observers considered to be osteo-arthritis, modified by its occurrence in an ataxic subject. But the clinical history seems to justify the separation of these cases into a separate class; the sudden and painless onset, the rapid destruction of the joint-surfaces, and the comparatively slight interference with movement, contrasting notably with the aching pain, the chronicity and the immobility of ordinary rheumatoid arthritis. *See* Charcot's Disease.

Hysterical Joint-affections: *Neuromimesis.*—The nervous mimicry of joint-disease is amongst the most common manifestations of the neurotic or hysterical diathesis. Such cases often resemble very accurately the true disease, especially in the position assumed by the limb, in the rigidity of the adjacent muscles, and in the character of the pain. But it will be observed that there is usually some inconsistency in the symptoms. Thus, it may be noticed that the pain is out of all proportion to the other evidences of disease; that there is no heat or swelling about the joint even after weeks of acute suffering, neither is there the muscular wasting which would have occurred in bone-disease; that inter-articular pressure does not give pain, while any attempt at movement is at once complained of; or the symptoms may vary in a manner incompatible with organic disease. The aspect and family history of the patient, and an account of the manner in which the affection commenced and progressed, will usually help the diagnosis. Sir J. Paget has pointed out the close alliance of this condition with insanity and other disorders of the nervous system; and it will often be found on inquiry that there is an hereditary predisposition to nervous disease, and that the joint-affection has followed closely upon some mental strain or disturbance. In doubtful cases, the administration of ether will often decide the diagnosis; for in the mimic disease the joint can be moved with perfect freedom and smoothness directly the patient is unconscious, and the unnatural posture and rigidity are only resumed when consciousness has been fully recovered, instead of, as in real disease, immediately upon the slightest return of sensation. Neuromimesis is not confined to the female sex, though it is more common therein (the writer has recorded a well-marked case in a boy of eleven years); it prevails mostly in young persons, and among the upper classes.

The *treatment* of this condition must be directed towards the improvement of the tone and stability of the nervous system; for this it is essential that all undue strain and excitement should be avoided. The habits and employment should be regular and of even tenour, plenty of food and rest should be taken, and the patient withdrawn from sympathetic petting and the society of persons of similar temperament. Any functional disturbance, uterine or otherwise, must be attended to; constipation, which is often prevalent and interferes with nutrition, must be overcome by proper medicines and diet; and, if indicated, tonics—iron, zinc, arsenic, valerian, and the like—administered: shower-baths, shampooing, and mild gymnastics may also be found useful aids.

For local treatment the first essential is that all splints and apparatus of restraint be cast aside. The patient must be encouraged to use the joint, and the necessary effort of the will may be sometimes aided by proving the mobility of the joint by a sudden and unexpected movement of it. The administration of an anæsthetic will occasionally produce a cure. It must not be forgotten that persons of this mobile and sensitive condition of the nervous system suffer in an exaggerated degree from any real cause of pain; so that any cause, however slight and apparently inadequate, for their suffering should be sought for and removed. J. Warrington Haward.

JOINTS, Excision of.—The excision of a joint implies the removal of part or the whole of the articular surfaces of the bones concerned, in such a manner that fibrous union or osseous ankylosis may result. This is usually accomplished by means of an incision laying the joint freely open, through which the bones are cleared of soft parts and divided at a level corresponding to the extent of the disease or injury.

Excision may become necessary on account of (*a*) disease, (*b*) injury, or (*c*) ankylosis.

(*a*) The disease most commonly calling for excision of joints is chronic synovitis.

When pulpy degeneration of the synovial membrane has rendered a joint useless, excision is often the best method of treatment. This is especially so if there be ulceration of the cartilages and caries of the articular lamella, and if chronic suppuration has occurred. So also caries or necrosis of the articular surfaces, chronic articular ostitis, and abscess of the articular end of a bone opening into the joint, are conditions in which excision may be successfully resorted to. Excision may occasionally, though rarely, be desirable in cases of chronic rheumatic arthritis.

Cases of acute disease are not suitable for excision; neither is it wise, as a general rule, to resort to the operation in persons past the middle period of life. In considering the question of excision of a joint, it must be remembered that a successful result requires a good deal of reparative power on the part of the patient; that the operation itself, if upon a large joint, is one of some severity; and that, in the lower extremity it involves a more or less prolonged confinement to bed, and for a time complete immobility of the limb. So that for persons past the period of youth, or of broken-down constitution, or who are worn and weakened by prolonged suppuration, or who bear confinement badly, amputation is by far the safer operation. Excision is, moreover, inappropriate in cases complicated with visceral disease, such as tuberculosis, amyloid degeneration, or Bright's disease. Yet the so-called scrofulous constitution does not forbid the operation, partly because the subjects are children, and also because the morbid tendency may to a great extent be counteracted by treatment.

The size and function of the joint concerned must also be taken into account. The larger the joint, and the nearer to the trunk, the more serious is the operation. Then with regard to function : in the knee and ankle, excision leaves the limb in much the same condition as when ankylosis occurs without operation, with the disadvantage of some shortening on the side of excision. So also the natural cure of hip-disease often leads to as useful a limb as is obtained by excision. In the upper extremity, ankylosis of the shoulder is to a great extent compensated for by increased mobility of the scapula ; but a stiff elbow-joint is so much less useful than a moveable one, and excision of the joint is so successful that the argument is much more often in favour of excision than of the other alternatives. The extent of the disease is also of much importance in deciding the question. For the complete removal of the diseased parts by excision would, in some cases, involve an amount of shortening which would leave a useless limb ; while in other instances, in which the bones could be successfully treated, the soft parts may be so extensively destroyed or undermined by suppuration as to preclude the probability of a satisfactory amount of repair.

Here again, however, it must be borne in mind that in situations where a moveable joint is desired, as in the hip, shoulder, and elbow, much more bone may be removed than if a stiff joint is the result aimed at, as in the knee. It is always desirable, if possible, to avoid dividing the bones beyond the epiphysial junction, both because of the increased danger when the medullary canal is opened, and because of the interference with the subsequent growth of the bone in young persons. The presence of sinuses leading to the diseased bone need not interfere with a successful excision ; but these canals, as well as any abscess-cavities in connection with the joint, should be scraped out with a Volkmann's spoon, or freely cleansed with a solution of chloride of zinc.

(*b*) Excision may be required in consequence of severe injury to a joint, such as compound comminuted fracture or gunshot wound. Here again, the decision concerning the operation must be based upon the same general principles as have been enunciated above with regard to excision for disease. The health of the patient, the size and function of the joint, the nature and extent of the injury, must all be carefully considered, as well as the possibility of obtaining the requisite care and nursing during the after-treatment. It will be obvious that the conditions, under which military surgery is usually practised, are not such as to admit of excisions of the joints of the lower extremity being performed with much chance of success. *See* GUNSHOT WOUNDS.

(*c*) Excision is also performed in cases of ankylosis, either for the purpose of improving the position of the limb or for obtaining movement by a false joint. In the upper extremity, excision of the elbow may be very properly resorted to in young and healthy subjects, to avoid the inconvenience of a stiff joint. In the knee, it would, of course, only be called for when the ankylosis has occurred in the flexed position. In the hip-joint, such a condition should be treated, not by excision, but by division of the neck or shaft of the femur.

The operation will of course vary with each particular joint, but the general principle is that the sections of the bones should be made at such points as will ensure the removal of the diseased articular surface, with as little interference as possible with the epiphysial junction or the shaft of the bone. The incision through the soft parts should be so arranged as to give free access to the joint ; the extent of the disease should then be accurately ascertained, and a corresponding amount of bone removed by an even section. Diseased synovial membrane and granulation-tissue should then be dissected out or scraped away, sinuses cleansed, and the whole wound rendered aseptic ; finally, the bones must be placed in an appropriate position, a drainage-tube inserted, and the wound in the soft parts closed by sutures. The dressings should be of antiseptic material, and the splints or other apparatus of restraint be so arranged as to allow of the dressing of the wound, with as little disturbance of the limb as possible. A dressing of dry carbolized wool appears to the writer to have the great advantage in this, as in many other operations, of absorbing discharge, of keeping up gentle elastic pressure on the part, and thus preventing oozing of blood and maintaining the wound in accurate apposition, and of an even temperature.

The subperiosteal method of excision has been advocated by M. Ollier and others, who claim for it the advantage that there is a more complete reproduction of the excised portions of bone, and that the attachments of the muscles around the joint are less interfered with than by the ordinary operation. The principle of the method is to cut down upon the ends of the bones entering into the joint, making the incision as far as possible parallel to the axis of the bone, then to separate the periosteum with the attached tendons and ligaments by the insertion of appropriate raspatories between it and the bone, and finally to divide the bone, either by turning it out of the wound or by passing round it a chain saw.

The operation is troublesome and tedious, and the separated periosteum does not always survive; if it does, however, there is doubtless usually an abundant production of new bone, more or less resembling in shape that which has been removed. But this is not always an advantage; for instance, in the case of the elbow, the irregular growth of new bone may be an impediment to the free movement of the new joint; and it is doubtful whether, in the majority of cases, any distinct gain results from the adoption of the subperiosteal operation as applied to joints. When, however, any large portion of the shaft of the bone has to be removed as well as its articular surface, it is very desirable to leave as much as possible of the periosteal sheath (which in such cases is often easily separable), so as to provide for the more complete regeneration of the excised bone, and obviate excessive shortening or flail-like union.

The after-treatment of joint-excisions must be directed to the maintenance of the nutrition of the patient and the promotion of the rapid healing of the wound. The larger excisions involve considerable shock, and make large demands upon the reparative powers, so that plenty of nourishing and digestible food should be given from the first. As much fresh air and sunlight as possible should be admitted to the room; and, in the case of the upper extremity, the patient should not be kept in bed longer than is absolutely necessary. The wound must be kept aseptic and at rest, that there may be as little formation of cicatricial tissue as possible. When, as in the knee, ankylosis of the bones is desired, absolute immobility must be maintained during the process of union, and the part supported afterwards by a proper splint. When a false joint is required, as in the hip and elbow, passive movement must be practised as soon as the healing is sufficiently advanced.

Excision of the Ankle.—This operation involves the removal of the articular surface of the tibia and fibula, and of the upper surface of the astragalus. It is practised both for injury and disease.

The cases of *injury* which admit of this operation are not numerous, for usually, if the bones of the ankle-joint are sufficiently comminuted to require resection, the soft parts are also so much damaged as to necessitate amputation. Nevertheless, some gunshot wounds and compound fractures of the ankle are met with, in which the main vessels and nerves have escaped, and in which the stress of the injury has fallen upon the bones; and in such cases, if occurring in young and healthy persons, resection should certainly be attempted.

With regard to *disease*, also, it must be admitted that, although chronic affections of the ankle-joint are sufficiently common, yet that cases to which excision can hopefully be applied are not very often met with. For, the chronic diseases of the synovial membrane and bones, which are so prevalent in this situation, are seldom limited to the ankle-joint proper, but commonly affect the bones and joints of the tarsus also. Yet we do meet with instances in which the disease is of traumatic origin, and occurs in subjects of otherwise good health, and in which the mischief is confined to the limits of the ankle-joint, and has not spread beyond the surfaces of the tibia and astragalus. These are the cases to which the operation of excision is most properly applicable.

The *operation*, as devised by Mr. Hancock, is performed as follows:—Esmarch's bandage having been applied, an incision is made over the outer ankle, commencing three inches above the tip of the malleolus, and running down the posterior border of the fibula as far as its point, and then passing forwards to within half an inch of the base of the fifth metatarsal bone. The flap thus marked out being dissected forwards, the fibula is divided with cutting forceps, and its lower two inches removed, the peronei tendons being left uncut. A similar angular flap is next turned up over the inner ankle, the incision running from three inches above the malleolus along the posterior border of the bone, and as far forwards as the inner cuneiform bone. The knife must be kept close to the bone, so as to avoid the posterior tibial vessels and nerve. The internal lateral ligament is then divided close to the tibia, and the foot twisted outwards so that the astragalus and tibia present at the inner wound. A narrow-bladed saw is then introduced through the inner wound and projects at the outer, and by this means the lower end of the tibia and the upper surface of the astragalus are sawn off.

The bones are then brought together so that the tibia and astragalus may become ankylosed, a drainage-tube introduced, and the wounds closed by sutures. The limb is then placed on a splint with the foot at a right angle to the leg. If the astragalus be found extensively diseased, the operation may be modified to the extent of removing all the bone instead of only its upper part; and in cases of injury, the amount of bone removed and the line of incision must of course be altered to suit the exigencies of the case. Repair after the operation is often slow, but in successful cases a most useful foot is left.

Excision of the Elbow.—This operation is required in cases of compound comminuted fracture, and in gunshot wounds of the elbow, in chronic disease of the joint, and in certain forms of bony ankylosis. In severe compound fractures, in which the lower end of the humerus is comminuted, the filling up of the fossæ into which the ulna plays is a common cause of impaired movement, so that a more useful limb is usually to be obtained by excision. When ankylosis has occurred in a useless or inconvenient position, or when it is desired to regain the movements of a fixed joint, excision may be undertaken with every prospect of success. Excision of the elbow is most often required, however, for chronic suppuration of the joint with ulceration of the articular surfaces of the bones, the result of degenerative synovitis, or articular ostitis.

Operation.—The joint is to be opened on its posterior aspect, either by a single longitudinal incision, or by a combination of this with a transverse incision made at right angles from its centre.

In cases in which there is very great peri-articular thickening, it may be convenient to adopt the method practised by Mr. Syme of making a longitudinal incision on each side of the back of the joint, joined by another across the upper border of the olecranon. In the majority of cases the single incision is sufficient. It should be made parallel to the outer border of the ulna, directly down to the bones, and be of sufficient length to allow of the soft parts being dissected off, and the bones protruded as far as their removal is intended. The joint should be opened just above the olecranon, and the condyles of the humerus carefully cleared by dissecting close to the bone.

Care must be taken to avoid injury to the ulnar nerve, which should be raised with the surrounding tissues from the groove between the internal condyle and the olecranon process, and drawn with the soft parts to the inner side of the condyle. In excisions for disease the nerve is not usually seen, as it is embedded in the adjacent thickened cellular tissue.

The lateral ligaments should next be divided, the forearm flexed, and the ends of the bones thrust out of the joint and sawn off. The ulna should first be divided at the level of the coronoid process, leaving the base of the process when possible; then the head of the radius is cut off, and lastly the humerus sawn through just above the condyles. Or, many surgeons prefer to remove only the olecranon process, thus gaining ready access to the interior of the joint. The lateral ligaments are then divided, the coronoid process and head of the radius sawn at the same level, and lastly the condyles removed through the supra-condyloid fossæ.

The wound should then be sewn together excepting where a drainage-tube is inserted, dry antiseptic dressings applied, and the limb placed upon an internal angular splint, or in the straight position on a pillow.

In the subperiosteal method, the bones having been freely exposed, the periosteum, with the attached tendons, is carefully separated with raspatories from the portion to be removed. The ulna is treated first, then the radius, and lastly the end of the humerus. There is nothing, however, to show that the results of this tedious proceeding are in any way superior to those obtained by the ordinary method; while, on the other hand, there are cases on record which prove that the reproduction of bone after the subperiosteal operation may be a distinct disadvantage, by interfering with the freedom of movement in the new joint.

Seeing that fibrous union is desired after excision of the elbow, a good deal of bone may be removed without interfering with eventual success; but the amount indicated above is that which is followed by the most satisfactory result, and is usually found to include the whole of the disease. If less is removed the movement obtained is apt to be limited; while, if more is taken away, the process of repair is less perfect, and a much longer time elapses before the muscles shorten sufficiently to act efficiently upon the forearm. Nevertheless, if the bones be extensively diseased, the surgeon may venture upon a more free excision in this than in most other joints; and the writer has seen what seemed, for several months, to be a flail-like union after excision eventually result in a perfectly efficient joint, with a limb as useful as that of the opposite side. It is well, therefore, to have patience with such cases, giving time for the muscular shortening to draw the bones together; and, should the disease recur, even to perform a re-excision rather than sacrifice the arm.

In the after-treatment of excision of the elbow the limb should be kept at rest till the wound is healed or nearly so; but at the end of three or four weeks it is well in most cases to begin passive movement. When more bone than usual has been removed, it is of course desirable to maintain rest for a longer period. The patient need not be kept in bed after the first week or two. The results of excision of the elbow are usually most satisfactory, an excellent false-joint being formed and very perfect movement obtained.

Excision of the Hip-joint. *See* Hip-disease.

Excision of the Knee.—Excision of the knee-joint is performed chiefly for chronic suppuration or pulpy degeneration of the synovial membrane, caries of the joint-surfaces, or chronic articular ostitis. It is also occasionally required in cases in which ankylosis has been allowed to occur, with the limb in a flexed position.

For *injury*, the operation is seldom practised. In the gunshot wounds of military practice the condition of the limb and the environment of the patient are seldom such as are necessary for a satisfactory recovery from excision of the knee; and in civil practice very few injuries of the joint are met with which, if they are of sufficient severity to call for operation, are not also too extensive to allow of successful excision. Primary excision of the knee, it must be remembered, is a very severe operation, requiring much greater reparative power than amputation, and only applicable, even when the local conditions are suitable, to the young and healthy.

For chronic *disease*, however, when limited chiefly to the synovial membrane, or affecting the bones only to a superficial extent, excision of the knee may often be advantageously preferred to amputation in young subjects, as a means of preserving a limb which, though ankylosed, may yet be very useful both for progression and support. Here again, however, it must be borne in mind that the operation is one of considerably greater severity than amputation, and requiring for its success a much greater amount of reparative power and a much longer period of careful after-treatment. The operation is therefore not suitable in persons past middle age, and seldom in those past youth; nor in those whose health has been exhausted by prolonged suppuration or pain; nor in cases of serious visceral disease, as tuberculosis or amyloid degeneration. Nor should it be attempted in any acute disease.

Operation.—This consists in freely laying open the joint at the front and sides, dividing the ligaments, and exposing the articular surfaces of the bones, so that a slice can be sawn off the femur and tibia, leaving two even surfaces of healthy bone to become ankylosed, with the limb in a straight position.

The most convenient incision is one commencing over the posterior part of one condyle, and extending in a curved direction across the front of the joint below the patella, to a corresponding point over the other condyle. This should divide the integument only, which should be dissected back from the patella and the front of the joint. The joint should then be freely opened by dividing the ligamentum patellæ and the lateral ligaments, while an assistant forcibly flexes the limb and thrusts the bones upwards out of the wound. The knife is then to be carried round the femur at the level at which the bone is to be divided, the blade being kept close to the bone and guided by the finger, and a slice of the bone is to be sawn off. The bone is to be sawn from before backwards and at right angles to the long axis of the shaft; and not more than about half the cartilaginous surface is to be removed, or the epiphysis would be encroached upon. The head of the tibia is then similarly cleared, so as to allow of its articular surface being sawn off just below the cartilage, the section also being kept carefully at a right angle with the shaft of the bone.

In using the knife or saw towards the posterior part of the joint, care must of course be taken to avoid injury to the popliteal artery, which is only separated from the bone by a small quantity of loose cellular tissue; the best protection against injury of the vessel being to have the bones thrust well upwards out of the wound. An ordinary amputation-saw may be used, and the bones be steadied by the lion-forceps. The patella is then removed and the diseased synovial membrane dissected or scraped away; after which the bones are to be carefully adjusted with the cut surfaces in even apposition, the soft parts brought together by sutures, a drainage-tube inserted, and the limb bandaged to an appropriate splint. All this should be done, and the patient placed in bed with the limb suitably supported and fixed, before the anæsthetic is discontinued.

The operation has been variously modified from the description here given. The transverse incision may be altered to two lateral ones joined by a third across the front of the joint, or a long semilunar flap may be turned back from the front of the joint; or again, the operation has been completed through the lateral incisions alone, the patella, with the attachment of the quadriceps, being left intact (Jones of Jersey). Another method is to saw through the patella transversely, and turn each half of the bone up or down with the adjacent soft parts; the operation being then completed in the usual manner, the cut surfaces of the patella are sutured together, the integuments adjusted, and the bone left in position (Golding-Bird). The writer believes, however, that in the majority of cases it is better to remove the patella.

Whatever method is adopted, the operation should be performed with antiseptic precautions, and every care taken to maintain the bones in accurate apposition and at perfect rest, so that firm bony union may be obtained. A variety of splints has been invented for application after excision of the knee. That most commonly in use is a metal splint with foot-piece for the back of the limb, to which can be fixed a bracketed side splint. A short anterior splint for the thigh is also sometimes a useful addition. Or the limb may be put up in a paraffine or gypsum bandage, enclosing a posterior light wooden splint and an anterior suspension rod. The splint and dressings should be so arranged, that the wound can receive the necessary attention without disturbance to the position of the limb.

The operation is a severe one, and is usually attended with considerable shock; so that in young and irritable subjects the free administration of opium is often desirable for a few days afterwards. The reparative powers must be assisted by a liberal diet, as much fresh air and sunlight as posssible, and, if needful, tonics and stimulants. In successful cases bony ankylosis occurs, but is not usually firm till about six months have elapsed. When the use of the limb is resumed, a leather splint strengthened by light metal plates at the back and sides must be worn for support, and an addition must be made to the sole of the boot to compensate for the shortening.

Excision of the Shoulder. — This operation is practised chiefly for chronic joint-disease, but may also be applicable to some cases of severe injury of the joint, such as gunshot wounds and compound fractures.

In *injuries* opening the shoulder-joint and involving severe comminution of the bones, it may be possible to remove loose fragments without sacrificing the entire head of the humerus; and it must be borne in mind in the treatment of such cases, that ankylosis of the shoulder leaves a more useful limb than usually results after excision of this joint. Nevertheless, in gunshot wounds and compound dislocations, if the head of the humerus be severely crushed, the complete excision of the injured portion of bone may save a long period of suppuration and separation of necrosing fragments.

For *disease* of the shoulder-joint, the removal of the head of the humerus is usually all that is needful, for the glenoid cavity is often only superficially affected, and may be treated by scraping, or left untouched. The condition for which the operation is most commonly performed is chronic suppuration of the joint, with ulceration of the cartilages and caries of the articular surface of the humerus, which has originated either in degenerative synovitis or in chronic articular ostitis.

Operation.—In ordinary cases, the joint can be conveniently exposed by a long straight incision, starting from the point of the acromion process (or, as preferred by some operators, close to the outer side of the coracoid process), and passing downwards over the head of the bone and a few inches along the shaft. The knife should pass directly down to the bone, and the soft parts, including the long tendon of the biceps, being held aside with retractors, the humerus should be rotated first outwards and then inwards to allow of the division of the muscles attached to the two tuberosities. This having been done, the head of the bone can be protruded through the wound and removed by the saw to whatever extent seems necessary, usually below the tuberosities.

The articular surface of the scapula should then be examined, and, if deeply diseased, may be removed by a narrow-bladed saw, such as is used for dividing the neck of the femur, or by strong cutting-forceps. This, however, should be avoided if possible and is seldom needful, for the disease is mostly confined to the head of the humerus; but any granulation-tissue or diseased synovial membrane adhering to the glenoid cavity should be scraped away with a Volkmann's spoon. In this, as in other excisions, a convenient protection to the soft parts when the bone is being sawn, is a strong curved steel director, made for the purpose, which is passed under the bone to be divided, and then turned, by means of a hinged handle, with its groove upwards towards the saw.

If, however, the head of the humerus be much enlarged, or there be abscesses or sinuses which require to be laid open, the first incision may be modified accordingly. For instance, a semilunar flap may be cut through the deltoid over the outer aspect of the joint, and the operation completed by the division of the muscles attached to the tuberosities, and the removal of the head of the bone in the manner described above. Or the joint may be opened posteriorly by an incision, starting from just behind the acromion and curving downwards and outwards, but stopping short of the bicipital groove and its tendon, which latter may be preserved if entire, as it seldom is in cases of disease.

For the subperiosteal method as practised by M. Ollier, a longitudinal incision is made down to the bone through the anterior part of the deltoid, a little behind the cephalic vein. The periosteum, with the tendons and other soft parts, is then separated from the bone by raspatories as low down as the section is intended to be made; the bone is then protruded from the wound and sawn through.

The divided vessels having been secured, and the wound rendered aseptic, a drainage tube should be inserted and the wound closed by sutures except at its most dependent part. After the dressings have been applied, a pad should be fixed in the axilla to prevent inward displacement of the bone; and when the patient is up, the arm must be supported in a sling. In successful cases a very useful arm is left, most of the movements excepting abduction being fairly performed. The arm cannot be raised above a right angle to the trunk, but the deltoid often regains considerable power of lifting it from the side.

Excision of the Wrist-joint.—This operation consists in the removal of the articular surface of the radius and ulna, the carpal bones, and the carpal ends of the metacarpal bones; and is practised in cases of caries and suppuration of those joints. The instances, however, to which this operation is applicable are not very numerous, for, in the majority of cases of extensive disease of the carpus, the soft parts are so immediately damaged, the tendons so matted together or destroyed, and the suppuration so diffused, that there is no prospect of obtaining a useful hand. Nevertheless, considering the importance of preserving, if possible, even a somewhat disabled hand, it is worth while to attempt the operation whenever there seems a reasonable probability of success; and especially as the results obtained by the method of operating introduced by Sir Joseph Lister are in successful cases very satisfactory. The operation is a tedious and somewhat severe one, requiring a long period of subsequent repair, and its success will depend very much upon careful and constant attention to the after-treatment.

The method of Professor Lister is as follows:—An Esmarch's bandage having been applied, lateral incisions are made in such a manner as to allow of the removal of the bones with as little injury of the tendons as possible.

The incision on the radial side commences on the dorsal aspect of the radius, on a level with the base of the styloid process; thence it passes towards the inner side of the metacarpo-phalangeal joint of the thumb, running parallel and internal to the tendon of the extensor secundi internodii pollicis; but, on reaching the radial border of the metacarpal bone of the index finger, it diverges at an obtuse angle, and is continued downwards along the border of that bone for half its length. In this way the incision avoids on the inner side the extensor of the index finger, and on the outer side the radial artery and the extensor of the thumb.

The soft parts on the radial side are next carefully detached, and the tendons of the extensor carpi radialis longior and brevior divided at their insertions. These, together with the extensor secundi and the radial artery, are then pushed towards the radial side and the outer bones of the carpus exposed. The connections of the trapezium with the adjacent bones are then severed with the cutting forceps, and the soft parts on the ulnar side of the incision raised from the carpus as far as convenient. The ulnar incision is next made along the subcutaneous margin of the bone, extending from two inches above the styloid process downwards, between the tendons of the extensor and flexor carpi ulnaris, as far as the middle of the fifth metacarpal bone. The tissues on the dorsum are then raised through this incision, and the tendon of the extensor carpi ulnaris is cut close to its insertion into the fifth metacarpal bone. The extensor tendons of the fingers are next raised from the carpus, but not divided, and the dorsal and internal lateral ligaments of the wrist divided. The anterior surface of the ulna is now cleared by dissecting close to the bone, the pisiform bone with the tendon of the flexor carpi ulnaris being separated from the rest of the carpus, and the hooked process of the unciform bone cut off with the bone-forceps. The flexor tendons having thus been raised, the anterior ligaments are divided and the carpal bones extracted with sequestrum forceps. The articular surfaces of the ulna and radius are next sawn off, the bones being pushed out of the lateral wounds, and then the bases of the metacarpal bones are removed by the cutting pliers.

The trapezium is now dissected out, care being taken to avoid injury to the radial artery and the tendon of the flexor carpi radialis; and then the metacarpal bone of the thumb is pushed up and its articular surface cut off. Lastly, the cartilaginous surface of the pisiform bone is removed, the rest of the bone, if healthy, being left, as well as the hooked process of the unciform.

During the after-treatment, besides attention to free drainage of the wound, it is most important to keep up passive movement of the fingers, to prevent the stiffness which would otherwise ensue. Before the commencement of the operation, and while the patient is under an anæsthetic, the adhesions of the tendons which are usually present should be broken down as far as possible. Systematic passive movement of each joint of the fingers should be commenced within a few days of the operation.

Sir Joseph Lister advises the use of a splint with a wedge of cork to raise the palm of the hand, so that the fingers can be exercised without removing the splint. As the parts consolidate, the wrist also should be moved and voluntary motion be encouraged; and when the wounds have healed, an elastic bandage may be worn for a term to give support to the wrist.

J. Warrington Haward.

JOINTS, Wounds of.—A wound of a joint may have a direct communication with the surface of the body, and be in this way exposed to contamination by particles floating in the atmosphere; or it may be subcutaneous, and thus protected from external influence. Between these two classes of injury there is a very marked distinction —one which the older surgeons did not fail to recognise, though they attributed the serious results of an exposed wound to the influence of the air itself, and not to the ferment-causing particles with which an impure atmosphere is loaded. A dislocation is perhaps as good an illustration of a subcutaneous wound of a joint as can be given; for when this form of injury is complete, it often happens that every ligament of the joint is ruptured, the articular surfaces are displaced and lie in contact with structures with which they have no natural affinities, the synovial membrane is torn and bleeding, the muscles in the neighbourhood are lacerated, tendons displaced, and vessels and nerves often seriously damaged. Yet, after all this disturbance of a joint and its environment, it often happens that, following reduction, no acute inflammation occurs, there is no general rise of temperature, and the severed parts reunite and readapt themselves to their normal functions in a marvellously short space of time.

Very different is the result when some small instrument has penetrated a joint, and exposed the surface of the delicate synovial membrane to the influence of a ferment-exciting or putrescent material. We then have developed all the symptoms usually described under the term *acute traumatic arthritis*, but, perhaps, more correctly named *septic arthritis*. A severe sickening pain is experienced by the patient, and the joint rapidly becomes swollen and, later, red. After some hours, when the joint has become distended with fluid, the pain becomes acute and throbbing in character, and severe constitutional symptoms begin to manifest themselves. The temperature rises rapidly, and the patient becomes restless and anxious. He loses appetite and may vomit his food; his tongue becomes furred, his pulse rapid, and his urine scanty and high-coloured. If the communication with the joint remain patent, the clear viscid synovia, which at first escapes, is followed by a more watery fluid accompanied by flakes of lymph, then by sero-pus, and later by pus. When pus is present in the joint the skin over it becomes œdematous and of a more dusky red, and the superficial veins become distended. Rigors, followed by a temperature of 103° to 105° F., and then profuse perspiration, may also occur, and the patient is in the greatest danger from general septicæmia. If relief be not given by free incisions, the distended capsule yields at its weakest points, and the pus burrows among the muscles and in the cellular tissue around the joint, tending to make its way towards the surface. Should the patient escape death from general pyæmia, he will be exposed for many months to the exhausting influence of prolonged suppuration and its accompanying dangers, and at last may recover with an ankylosed joint.

The *pathological changes* which take place in a joint thus injured are first evident in the synovial membrane, which becomes injected and red, whilst its fringes are swollen and turgid; its surface soon loses lustre, and its cavity becomes filled with a watery, opalescent fluid containing lymph-flakes, leucocytes, and bacteria. The further progress of the inflammation is characterised by the rapid growth and intense vascularity of the synovial membrane, which brings it into strong contrast with the slow-growing œdematous granulations present in pulpy disease. Under its influence the cartilaginous surfaces become quickly destroyed, leaving at first, here and there, isolated portions of apparently healthy cartilage. The granulations developed in the joint in the later stages may be coated with a greyish lymph, giving them a sloughy appearance, and the interior of the joint is then bathed with pus. The ligaments, as the result of the inflammation, become softened and, under the influence of the muscles, may give way and allow of dislocation. The cartilage is also in part removed by granulations springing up from the bone. For a time the joint may be an abscess-cavity lined throughout with granulations; then these meet, interlace, and unite, becoming converted first into fibrous tissue, then into bone, as a result of which process ankylosis is effected.

Not every open wound of a joint is followed by the acute septic inflammation described, and the milder type of inflammation which frequently occurs bears some relation to the nature of the wound inflicted, but depends mainly upon the absence of infection by impurities in the air or on the penetrating instrument. It has long been known that a clean incised wound may be made into the knee-joint for the purpose of removing a loose cartilage, and that, with care, primary union may be obtained and little or no synovitis follow. An even severer test is the operation devised by Ogston for knock-knee, wherein a narrow saw is introduced into the knee-joint and the internal condyle sawn off. The joint becomes a receptacle for blood and bone-dust, yet rarely inflames severely as a consequence. The writer has sawn off the internal condyle of both knees of a patient on the same day, and the temperature during repair has not risen above 100° F. The free incision of the knee-joint, made for the purpose of wiring a fractured patella, may be also cited in illustration of the difference between an aseptic and septic wound of a large joint. Lacerated and bullet wounds of joints are among the most serious, inasmuch as primary union in these cases is almost impossible, and suppuration or sloughing of the skin-edges will almost certainly convey septic matter to the interior of the joint. The addition of splintered fractures, which often complicate gunshot injuries, renders these even more dangerous and difficult to treat.

A large wound of a joint is not necessarily more grave than a smaller one, even when primary union cannot be obtained; for a wound of considerable extent allows of freer drainage, which is one of the most important considerations should acute inflammation follow. When acute traumatic arthritis has set in, the size of the joint will be found to bear a definite relation to the amount of constitutional disturbance excited; and when prolonged suppuration results, childhood or youth will bear the strain better than adult life or old age.

The *diagnosis* of a wound of a joint may be made by noting the escape of viscid synovial fluid, by the exposure of articular cartilage, or by the depth to which a wound over a joint is found to penetrate. The first sign alone is usually sufficient, but a wound of a bursa in the vicinity may lead to error, as when the ligamentum patellæ is partially divided and the bursa behind it opened. Exposure of cartilage requires no comment; but the advisability of probing a wound to ascertain if it has penetrated the capsule is at least doubtful, and should be performed with great caution. It cannot be too strongly insisted upon that the probe should be disinfected before being used, and, in the presence of bad air, when no spray is at hand, it may be well to drop some disinfectant fluid from a sponge over the wound during the probing, to sterilise any air which may tend to enter. If the wound be large and it be a question of foreign body or splintered bone, the finger, first dipped in some disinfectant fluid, is a far better instrument for determining the nature of the injury than any probe.

The *treatment* of wounds of joints depends largely upon their character and extent, but, in every case, it may be insisted upon that complete fixation and rest upon a splint are among the most essential provisions for favouring recovery. The form of splint employed will vary with the practice of the surgeon, and in simple cases will matter little; but the writer is strongly of opinion that the splint, padding, and bandages should be so arranged that, in the event of suppuration, no change need be made. It is well, therefore, to fix the limb from the first upon a metal splint lined with waxed lint and secured with waxed bandages, that in the event of suppuration they may not be soaked with discharge, and thus become a hot-bed of decomposition. A small, clean, incised wound will often heal immediately under a pad of lint dipped in the old-fashioned antiseptic—compound tincture of benzoin. It is advisable, when trusting to simple remedies, to place over the joint an ice-bag or a Leiter's coil to lessen the tendency to inflammation. An incision of larger size may be brought together by fine wire stitches, and a piece of green protective and carbolised gauze dressings may be applied over the wound; these can be removed at any time under the spray, for the purpose of taking out stitches or securing drainage. Should the wound be soiled at all with dirt, the greatest care should be taken in cleansing it with an antiseptic lotion, and in gently syringing away any adherent particles. The wound in this case should only be closed at the upper part, the lower being left open for drainage, and antiseptic dressings should be employed. When it is clear that the joint has been exposed to contamination through a lacerated or contused wound of considerable extent, some more thorough means should be resorted to for allaying, as much as possible, the inflammation which may be anticipated. The joint should be thoroughly syringed out with a five per cent. solution of carbolic lotion, and counter-openings should be made at the most dependent spot on either side of the joint for the insertion of drainage-tubes. The whole should then be covered with antiseptic dressings, which should be reapplied every day, or whenever the discharge may have soaked through them. The drainage-tubes may often be removed in five or six days, but, if the discharge be profuse, they should be retained until it lessens. In any case, where acute suppuration with high fever follows a wound of a joint, free and dependent incisions should be made to allow of the escape of pus.

There are other cases of wounds of joints where the surgeon cannot hope to save the articulation, and in which he will have to decide between excision and amputation. Extensive laceration of the soft parts around an open joint will generally call for amputation, but the age of the patient has a strong determining influence in many cases where excision is practicable. It must be here remarked, that excisions for injuries of joints do not run the same even course towards recovery that excisions for disease may be expected to follow, and this is mainly due to the lacerated and bruised tissues having already become contaminated with living organisms. Hence a good deal of suppuration is apt to follow, and the surgeon has a difficulty in keeping the wounds sweet. To expose an old person to this exhausting process can never be advisable, and, therefore, after the middle period of life, there are few cases in which excision can be adopted in preference to amputation. How far fractures complicating the wound will weigh on the side of amputation or excision, may sometimes be decided by the position of the joint. Thus, at the knee, should there be much comminution, after the removal of the fragments it may be impossible to adapt the ends of bone so as to obtain the necessary ankylosis; whereas at the elbow the usual treatment after excision is directed towards the avoidance of ankylosis, and great sacrifices of bone may be made to save the hand, even though the arm remain a flail.

In the general treatment of a wounded joint there is much that requires attention. The diet during the early inflammatory stages should be light, nutritious, and unstimulating; whilst in the later stages stimulants may be freely administered and a liberal diet be given, to support the patient's strength whilst suppuration is proceeding. In the inflammatory period an effervescing saline mixture is of advantage to the patient, and in the later stages quinine and iron are of service; but opium is the drug which gives the patient most relief, and is almost essential to procure for him the necessary rest. A hypodermic injection of a quarter or a third of a grain of morphia may be given every night till the pain subsides. Chloral and bromide of potassium may occasionally be used as substitutes, but they are, as a rule, less to be relied upon than opium. R. Clement Lucas.

JUGULAR VEIN, EXTERNAL, Venesection of the. *See* Venesection.

JUGULAR VEINS, Wounds of the, may complicate homicidal or accidental injuries of the neck, or may occur during operations upon tumours, &c. Those of the internal jugular are most important. They may prove fatal from the loss of blood, the admission of air, or, at a later stage, from purulent infection through detached clots. Occasionally, after passing a tenaculum through both edges of a small wound in this vessel, surgeons have successfully applied a ligature round a portion only of its circumference. But it is better to pass an aneurism needle beneath the vein, and, having surrounded it with a double ligature of silk or catgut, to tie one part above and the other below the opening. There appears to be no danger from the disturbance of the cerebral circulation thus produced, and the risk of thrombi being carried into the circulation is very much diminished by this mode of treatment. A wound of the anterior or external jugular vein usually requires only the pressure of a small pad; but, if it is made during the course of an operation, it is prudent to ligature the vein above and below the wound. N. Davies-Colley.

JUNKS.—The junk proper consists of a thin cushion measuring, for an adult, 26 inches by 15 inches, stuffed moderately firmly with horsehair, and, when new, about 2 inches thick. To prevent displacement of the stuffing whilst in use, the cushion must be sewn through or 'tufted,' to employ the technical term. The cover is best made of ticking. The cushion can be strengthened, if necessary, by longitudinal strips of cane sewn into the cover on its outer side, and, thus made, forms a strong splint for the leg, especially useful in military surgery. The apparatus is completed by the cover, which consists of a piece of strong calico or cloth ('loom linen sheeting,' specially made in Dundee for hospital purposes, is the best material), measuring 26 inches by 16 inches. Two cylindrical pieces of stick or thick cane, 22 inches in length and 1 inch in diameter, are sewn into the edges as in an ordinary 'wringing' contrivance. The cover is retained in position by two straps or webbings, encircling the whole apparatus.

The leg is placed in the junk, the lower end of the cushion projecting a few inches beyond the heel; the cover is placed outside the cushion, which is then bent up into the form of a trough, when completed, by buckling the straps. The foot usually requires some support. This junk is well adapted for the treatment of sprained ankle, fractured fibula, fractures of the leg with much swelling, or as a fixation apparatus for 'first treatment' of fractures, or when it is necessary to transport the patient. It has the disadvantage of being rather hot, and is apt to get foul if used for cases where there is much discharge. A pillow and a piece of common sheeting make a very efficient roll junk on an emergency.

The ordinary junks are merely flat cushions, measuring (for adults) 28 inches by 16 inches, and, when newly stuffed with horsehair, from 4 inches to 6 inches thick. They are best covered with strong ticking and should be tufted. These junks are used to keep limbs raised, and are usually placed, wrapped in a draw-sheet, under the injured part, but often are more comfortable when placed beneath the mattress. When used for cases in which there is much discharge they should be wrapped in macintosh sheeting.

A special and very useful form of junk is made in the form of an inclined plane. The side elevation (for an adult) should have the following measurements: Length of base, 24 inches; height, 10 inches at one end, sloping down to 3½ inches. A convenient width for the junk is 16 inches. The inclined plane is hollowed out into a trough about half an inch in depth at its shallowest part, and adapted a little to the shape of the leg and thigh. The junk is firmly stuffed with horsehair and covered with ticking. It is admirably adapted for elevating and resting the limb in cases of fractured patella, synovitis of the knee, &c. The patient must be kept on his back, and, in this position, is unable to bend the knee. A single fold of bandage, passing over the thigh and secured on either side to the junk, is sufficient to fix the limb. The foot usually requires a little support. The apparatus is also well suited for elevating and resting the arm.

Stump junks are small pillows, stuffed with horsehair covered with ticking, and designed to support and raise the stump after amputation. If too much stuffed they are apt either to press injuriously on the stump or to allow the stump to slip off readily. Many surgeons employ splints for stumps immediately after amputation. When this is done, the junk can be fastened to the splint.

In using junks, of whatever shape, to raise and support an injured limb, care must be taken to give uniform support to the whole of the limb. For example, if the leg alone is raised on a junk, after an hour or two much discomfort will be felt from the strain thrown on the hamstrings. Injudicious arrangement of junks will greatly disturb the fragments in fracture.

C. T. Dent.

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KANGAROO TENDON LIGATURE is prepared from the tail of the kangaroo. When fresh, the tendons may be split up to any thickness required, and average about eighteen inches in length. They may be preserved dry for any length of time, or kept in some antiseptic solution. Before use, they should be soaked for at least twenty-four hours in carbolic solution. When soaked, they swell up to about twice the thickness they have when dry. Care should be taken that the tendons chosen for use show no longitudinal split, and that there are no nodosities in the course of the ligature. This ligature is best suited for tying arteries in their continuity. The writer has used them, with great advantage, for large atheromatous vessels in amputations, in cases of varix and varicocele, and for the ligature of the stump in castration. They would seem to be well suited for cases of oöphorectomy and the like. The knot should be tied without any jerk as firmly as may be desired, and the ends cut off short. The changes that follow in the ligature, consist in the splitting up of the tendon into longitudinal bands by an infiltration of small cells. These cells elongate, and subsequently form the walls of newly-developing capillaries, similar to those seen in granulation tissue. New blood-vessels also, forming in the coats of the artery, pass out into the interspaces of the tendon fibres. This is the process termed 'organisation of the ligature.' The tendon itself sets up no irritation whatever, if perfectly aseptic. It disappears very much more slowly than the catgut ligature; there is no need, therefore, to rupture the internal coat of the artery, though such rupture in all probability usually takes place. C. T. Dent.

KELOID. *See* Cicatrices, Pathological Conditions of.

KERATITIS. *See* Cornea, Inflammation of the.

KIDNEY, Injuries of the.—Injuries of the kidney are by no means uncommon, both in peace and war. They may be classed as 'non-penetrating' and 'penetrating.'

Non-penetrating Injuries of the Kidney.—*Symptoms and Diagnosis.*—These in civil life are most frequently produced by falls upon the back or side, by crushes, as in the case of 'buffer accidents' on the railways, or by carriage accidents in the streets, where the flank is struck by the shaft, or a wheel passes over the waist. Cases are also recorded, in which indirect violence has caused rupture of the organ. Thus, falls upon the buttock have been known to cause a tear of the kidney by the severe jarring induced. These and similar kinds of violence will produce, without any external wound, every degree of damage, from a slight bruise or tear in the cortex to complete pulping of the whole organ.

Symptoms (Objective).—A bruise or laceration of the kidney from non-penetrating violence to the side is recognised, in the first place, by the appearance of *blood* in the urine. This blood is, as a rule, thoroughly mixed with the voided urine, which varies in colour from slight 'smokiness' to bright red, and, unless poured out in great amount, does not form clots. When very abundant the latter are produced freely, and may even completely prevent the passage of the remaining blood and urine through the ureter or urethra. These symptoms, together with the history and the presence of bruising of the soft parts, will often be enough for a diagnosis. But there will occasionally be felt, besides, a *fulness in the flank* corresponding to the situation of the kidney. This may appear immediately after the injury, and, in such a case, will be due to the outpouring of blood from the wounded organ, either into the areolar tissue external to it, or under the capsule external to the surface of the kidney, or into the distended pelvis, the ureter being blocked by clot or bruise; in the latter case the hæmaturia will quickly cease. If the fulness make its appearance a little later, after the lapse of some hours, it is more likely to be urine effused in the same regions, though it may still, possibly, be blood. Bleeding from a moderate injury to the cortex soon ceases, as a rule, so that the amount of blood effused will probably not be sufficient to form a swelling in the loin, perceptible to the fingers. But if the peritoneal aspect of the organ be torn, there will usually be more or less blood poured out into the abdominal cavity, which will be perceptible or not by palpation and percussion in different positions of the body, according to its amount. If abundant, the dulness will be quite apparent, and the diagnosis will be aided by the weakness and pallor due to loss of blood. If the effused fluid in this case were *urine*, neither of these last two symptoms would be present, and the patient might continue to improve in strength and colour as the effusion increased, until possibly peritonitis set in with its usual symptoms. Besides these symptoms, wounds of the kidney have been observed to produce *retraction of the testicle* and *frequency of desire to micturate*, but this is not invariably the case.

The *subjective* phenomena usually noticed with injury to the kidney are, first, *shock*, although this is due more to the violence to the parts around than to the renal lesion. As is pointed out under Kidney, Surgery of the, there may be little or no shock observed in those cases where the injury is limited to the kidney alone. Next in order comes *pain*, that complained of being usually of a dull, aching character, increased to a sharp 'stitch,' perhaps, by deep inspiration or exertion of the abdominal muscles. But most characteristic of all is great *tenderness on palpation* in the situation of the kidney. This tenderness, taken in conjunction with the other symptoms enumerated, leaves no doubt as to the diagnosis. But in some cases a clot may form in the ureter and prevent the passage of blood into the bladder, the urine first drawn off having perhaps a trace of blood, but that subsequently voided being clear. Here, however, the patient will almost certainly show all the evidence of the condition known as renal colic, which in itself is very characteristic. *See* Renal Colic.

Diagnosis.—In forming a diagnosis in these cases, we are most concerned to know, in the first place, whether the blood seen in the urine comes really from the kidney, bladder, or urethra; and next, to what extent the kidney is damaged if it be the source. Blood derived from the bladder, unlike that coming from the kidney, is not *usually* thoroughly mixed with the urine (although sometimes perfectly so), and shows clots, or varies in the amount seen in the stream during micturition. At the end of the act there is usually some apparently pure blood passed, and often with much pain and straining, owing to the difficulty in forcing the clots through the urethra. If the bladder be ruptured, the blood may come away almost pure and unclotted, but the power of the bladder is gone. Blood derived from the urethra, on the other hand, is usually passed pure at the beginning of micturition, and is followed by clear urine producing little or no pain. *See* Hæmaturia.

Wounds of Pelvis.—That the pelvis of the kidney may be wounded by non-penetrating injuries independently of the kidney is proved by, at least, two cases; but the author, after careful search, is unable to find any others recorded in home or foreign literature. The first case was reported by Mr. C. Hawkins; the next occurred in the practice of Mr. Vincent, of St. Bartholomew's Hospital. In both, the pelvis was injured by the same kind of violence—viz. a cart-wheel crush—and both died about ten weeks later from spurious hydronephrosis or urinary abscess. By this is meant an effusion of urine into the post-peritoneal tissues, with the formation of a distinct sac limited by plastic inflammation. The *symptoms* were practically the same as those of ruptured ureter (vide *infra*). The nature of the case was not recognised during life; but after death, in both instances perforations of the anterior wall of the renal pelvis, leading into the newly-formed sac, were found.

Wounds of Ureter.—The only case known to the writer in which a positive diagnosis could be made, during life, of injury to the ureter alone from a non-penetrating injury, is that of a child lately under his care in University College Hospital. This patient, a boy of three years and eight months, was run over by a cab in August 1884, the wheel passing across just above the right iliac crest, and leaving extensive bruising of the parietes. At first nothing was to be made out but this bruising and some hardness of the side; then, some days later, a swelling with all the characters of hydronephrosis was felt on the right side. This was aspirated, and forty-five ounces of fluid were drawn off with all the characters of urine, but containing (as was to be expected of urine secreted under pressure), only a small percentage of urea, (0·5 per cent.); it also contained albumen. This aspiration was repeated on six occasions at intervals of about a week, with practically the same result. The *symptoms* upon which the diagnosis was based were—first, the nature and position of the injury, then the absence of severe shock, then the presence of two small worm-like clots in the urine first passed, not followed by any bleeding, and lastly the formation of a fluctuating tumour in the renal region, dull on percussion, of a distinctly rounded form, with the liver above and the colon in front of and internal to it; finally, by the result of the exploratory aspiration, which gave exit on each occasion to fluid with all the characters of urine and a definite amount of urea. This urea was present in very small amount so long as the sac was a closed one, but, as soon as a drain-tube was introduced and the fluid allowed to drain off without any obstruction, the percentage rose to 1·7 for many days. Here the writer proved the accuracy of his diagnosis by excising the kidney, which at once arrested the flow and relieved the child from all his distressing symptoms. In this case the urine was poured out into the areolar tissue behind the peritoneum, and there formed a large sac for itself, bounded by plastic inflammation. The wound of the ureter appears to have been not far below the pelvis of the kidney, the lower end of which was found, on excision, to be covered with granulations and phosphatic matter. The pelvis was healthy. The urine might, in another case, be poured out into the abdomen, being limited by lymph to a definite sac, or the torn end might be closed by clot or plastic material and the pelvis of the kidney be distended; or, finally, the last condition might be produced by simple bruising of the ureter, without destruction of its continuity. A case very like the above was recorded in 1843 by Stanley, but the patient recovered, and a positive diagnosis was impossible. These are the only instances known to the author of injury to the ureter alone.

Penetrating Injuries of the Kidney. But the kidney may also be injured by direct violence *penetrating* through the surface of the body, and many interesting cases of the kind are to be found, especially in the records of military surgery. Thus, it has been slit from top to bottom with one or other form of sharp instrument, as well as punctured by bayonets, lances, and swords. The wound in the flank has, in some cases, allowed the kidney to be forced out on the surface in the act of coughing. In many of these cases there was little or no constitutional disturbance, and the patient recovered quickly after replacement or removal of the protruded kidney. Again, the organ has been wounded by bullets either passing quite through it or lodging in its substance, recovery in each case being frequent. Any of these injuries may implicate either the proper renal tissue alone, the pelvis, or the ureter alone; and the symptoms, prognosis, and treatment will vary accordingly in each case.

The difficulties in the *diagnosis* and *prognosis* of penetrating wounds of the kidney are usually smaller than in the case of non-penetrating wounds of that organ. We have in the first place the *direction of the wound* and the nature of the weapon to guide us. For a simple uncomplicated wound of the healthy organ to take place, it can only be reached over a limited area in the loin just below the ribs, and then only in its lower portion. Except here, no penetrating wound can reach the kidney without producing a lesion of far more important parts, which will mask the renal mischief. Then the *amount of blood* effused immediately on receipt of the injury will aid the diagnosis; bleeding from the kidney being usually very free for a short time, but soon ceasing altogether. Renal blood in the urine, passed *per urethram*, is an almost constant symptom from the very first in all these cases; but this bleeding may be so free as to give rise to clots in the ureter or bladder, with all the intense suffering of renal colic or urethral dysuria respectively. *See* Renal Colic. *Retraction of the testicle* and *increased frequency of micturition* are often marked symptoms in these injuries. The *pain* in an uncomplicated case will be but an uncertain guide; but, on the other hand, we may be able to see the organ, which has often been partially or completely prolapsed through the wounds in the soft parts. As to *shock* after penetrating wounds, it may or may not be present, depending as it does rather on the effects of the wound upon the neighbouring structures than upon the kidney itself.

It may be conveniently noted here, that we are not to expect urine to flow from the first out at the lumbar wound, when the kidney has been damaged. As a rule this has not been observed for several days, or even in some recorded cases for weeks after the injury. In some cases again, urine does not appear at all in the external wound. But in those instances in which the latter does not heal kindly, urine usually makes its appearance at about the same time that suppuration becomes free in cases not completely aseptic — viz. about the fifth day or so. Having once commenced to escape from the lumbar wound, it may continue to flow for an indefinite time, amounting to months or years. But it may be stated generally, that penetrating wounds of the kidney through the loin have usually a great tendency to heal. Indeed, this is often one of the most serious points about them; for, if there be any suppuration, inflammatory swelling is apt to diminish or even completely arrest the flow of the urine down the ureter, and thus the only mode of escape for the products of inflammation and the secretion is through the wound. If, then, the latter close, there are, as a rule, the most severe constitutional disturbances — fever, anorexia, insomnia, &c.—lasting until either the wound has burst open again or has been re-opened by operation. This point ought never to be lost sight of, as it will materially influence the question of trying to make a permanent urinary fistula in the loin in preference to performing an early nephrectomy, which in many cases would be attended with less risk than usually follows tedious suppuration here.

Treatment of Injuries of the Kidney. This will depend upon whether the injuries are *penetrating* or *non-penetrating*, *recent* or *suppurating*. In the case of *penetrating* wounds, as they will probably be either incised, punctured, or bullet wounds, the earliest danger will be hæmorrhage. This may often be controlled by the application of firm pressure by the hand or bandage, with the addition of the ice-bag. Bleeding from the arm, until syncope has been produced, has also been resorted to with the best results in healthy plethoric individuals. Then, the hypodermic injection of ergot and free doses of gallic acid should be tried. If, however, one or more of the larger branches about the hilus is wounded, and neither pressure, cold, nor internal styptics are sufficient, there is little doubt that the proper course to pursue is, to enlarge the wound in the soft parts and seek for the bleeding vessel. If this be not easily found and secured, it is best to include the whole pedicle in one ligature and remove the kidney. *See* Nephrectomy. Cases intermediate between these two may be treated by plugging the wound with some antiseptic dressing, as iodoform or salicylic wool, with firm external bandaging and cold. The whole treatment, from beginning to end, should be conducted on the strictest antiseptic principles. In those instances in which the organ is prolapsed through the side as well as wounded, if seen at once it may be replaced after careful cleansing, and some such cases have recovered perfectly. But if it have been long prolapsed, strangulated, and rendered thoroughly foul, or otherwise seriously damaged, there ought to be no hesitation about its immediate removal after ligature of the pedicle.

In the case of *non-penetrating* injury to the kidney, the immediate treatment will be essentially the same as the above in the milder forms; but when severe, the surgeon is justified in waiting longer before resorting to operation on the organ, in view of the greater uncertainty in diagnosis. But here, too, where injury to the peritoneum and other organs seems improbable, and the patient is bleeding slowly to death through his ureter or into the perinephral tissues, if other means have failed the surgeon will be justified in cutting down and removing the torn kidney. In addition to the local treatment of the renal wound, another condition depending upon the hæmaturia will require careful attention, and that is the formation of clots in the bladder. This is often a source of much suffering and some danger; the clots may be too large to pass out by the urethra, and in their attempt to do so they act as a valve and completely prevent the escape of urine. The latter then goes on accumulating to an enormous extent, and causes most acute suffering. Any endeavour to relieve the bladder by an ordinary catheter fails in most cases, from clogging of the instrument at the outset. In the female, the urethra may be dilated in the usual way, and the clots extracted through a speculum. But in the male, washing out should be avoided, as the injected water will increase the distension and will not return. The use of Bigelow's large catheters and suction bottle will, probably, in the future supersede all other active treatment for the adult. The pelvis should be well raised while this is being used, so as to throw the clots well back from the neck of the bladder. By this suction-method the writer has lately succeeded in removing large clots, otherwise impossible to evacuate. If all means fail, we must only wait for the softening of the clots, and endeavour to relieve the suffering in the meantime by anodynes, with hot-air baths to diminish the flow of urine from the kidneys. The clots will usually break down in the course of a day or two, the relief being then speedy.

It should never be forgotten that bleeding from the kidney, with or without external wound, may be made to return, days or weeks after it has ceased, by over-excitement of the organ, such as the use of strong drinks or fluids which throw much work on its excretory functions.

The treatment of suppurating penetrating wound of the kidney will depend upon the extent of the injury in a great measure. If diagnosed to be moderate in degree its eventual closure, if kept aseptic and carefully drained, may still be hoped for, and this line of treatment should be tried. But as a rule the external wound tends to close long before the urine has returned to its normal route down the ureter, if it ever does this at all. This tendency to closure of the wound is most troublesome if the ureter be impervious, and often leaves the surgeon but little choice as to his line of action eventually. Increasing experience points to the conclusion that it would be well to perform nephrectomy early in such cases—that is, so soon as there appears to be no reasonable hope that the closure of the wound will be permanent. But in cases of extensive injury, where suppuration has commenced, nephrectomy should be undertaken very early if the patient's condition be otherwise satisfactory. Here we can hardly hope for proper repair of the organ, and the risks of prolonged suppuration, with decomposition of urine, in this region are very great.

The treatment of suppurating non-penetrating wounds, which are rarer, but which, when met with, indicate very grave lesions of the organ, probably associated with extravasation of blood and urine around, is a most difficult question to determine. In these cases, free antiseptic incision and drainage appear the proper means to take; but on incising, the organ should be carefully examined with the fingers, and if much injured it should be removed immediately. This will at once do away with the risks of bleeding and reduce the amount of decomposition, and will not add very materially to the shock. The treatment of bullet wounds of the kidney must be conducted upon the same principles which guide us in dealing with punctured wounds of the organ. But an element of danger is often met with here not present after ordinary penetrating wounds—namely, the presence of a foreign body. This is either the bullet, a fragment of a rib, or some material carried with the bullet in its course, such as a portion of clothing. Now, if this is left *in situ*, we may usually look forward to very prolonged suppuration. It is therefore better to anticipate this by extraction, if possible, of the foreign body, and in seeking for it we must not shun free incision either into the soft parts or the kidney itself if necessary. But, if the kidney have been much disorganised by the projectile, and extensive suppuration have been the result, it will probably subject the patient to less risk to remove the kidney early, than to leave the foreign body to be thrown off by disintegration, and the wound to granulate up. Cases, however, are on record where bullets have passed into or through the kidney, making a clean wound, which has healed up without any complication. Also, foreign bodies driven into the organ by a bullet have, in certain cases, after a time passed down the ureter and out *per urethram.*

The treatment of wounds or rupture of the pelvis or ureter will be the same in most cases—i.e. repeated aspiration from behind, until we have convinced ourselves of the nature of the tumour by an analysis of the fluid, especially its percentage of urea if any, and until we have satisfied ourselves as to the soundness of the opposite kidney by a careful daily examination of the urine passed from it. (See *Lancet*, January 17, 1885.) If the kidney on the damaged side show any signs of ceasing to secrete, we must wait; but if not, we may try antiseptic drainage from the loin. This, however, from the evidence of recorded cases, seems a very unsatisfactory proceeding where a healthy organ is being dealt with, on account, among other things, of the blocking of the drainage opening by phosphatic concretions and grave constitutional disturbance consequent thereon; and sooner or later it will be necessary to remove the kidney itself in most cases.

Arthur E. Barker.

KIDNEY, Surgery of the.—The surgery of the kidney includes the consideration of two great groups of conditions—viz. injuries and diseases of the organ, which will be considered severally under special headings.

A great variety of *injuries* to the kidney has been described, but these have for the most part been associated with damage to other besides the renal structures, and the phenomena observed in connection with them have been complicated. When simple and uncomplicated, injuries to the kidney are not so serious as has usually been supposed, the chief dangers being, first, hæmorrhage; second, extravasation and suppuration, with all its attendant risks of septic infection and exhaustion. Shock has been purposely put last of all, for it is a mistake to suppose that wounds of the kidney alone are necessarily followed by much shock; this is not so. The organ has frequently been punctured, slit open, or otherwise wounded, without any notable effect upon the patient's nervous system; it has even been removed without an anæsthetic, and the operation has given rise to little or no suffering or general disturbance in the patient's system. It is rare, however, for injury to reach the kidney exclusively, and when the peritoneum, intestine, liver, spleen, or nerve-plexuses and vessels of the neighbourhood are involved in the same violence, then it is that the severe shock is seen so frequently, and erroneously attributed to the damage to the kidney.

Hæmorrhage also, though it is one of the great dangers after wounds of the renal tissues, is not necessarily severe, as is often supposed, even when the injury is extensive. It is only when some of the larger vessels towards the hilus of the organ are divided, that great bleeding is inevitable. This has been shown over and over again, as well by accident as when incisions have been made into the organ in the living subject; the bleeding, as the writer has seen in some of his own cases, and also in several in the practice of others, has been free for the moment, but has ceased very quickly either spontaneously or on a little pressure. It is otherwise, of course, when any of the larger renal vessels are torn, especially the veins; but even then, firm pressure and the application of cold, with ergot or gallic acid internally, will often arrest the bleeding. It is important to remember this tolerance of the renal tissues to injury; it will encourage us, on the one hand, to await patiently in certain cases the efforts of nature for the repair of injuries to the organs, and, on the other, it will stimulate us to undertake, in special instances, the local treatment of severe lesions more promptly and fearlessly than has yet been done.

As has been noted of bleeding, so it may be said of extravasation of urine, that in uncomplicated cases of moderate injury to the organ, this is not a certain or even frequent consequence. Slight bruises, lacerations, or incisions of the organ usually heal rapidly, without the pouring out of urine to any dangerous extent, and even in severe lesions this is not always a prominent factor. When either the pelvis or ureter is torn, urine may continue to be secreted into the post-peritoneal tissues without any immediate danger to life, the fluid being aseptic and of a non-irritating character when the organ is healthy. Effused into the peritoneum, it is usually followed by peritonitis, but not of an inevitably fatal form, as it may become limited by lymph and so form a sac, within which it is almost harmless.

Again, suppuration rarely follows simple and uncomplicated wounds of the kidney of moderate degree, and is only seen when a patient survives the severest lesions, and there is an abundant effusion of blood and urine around the organ. It is not necessarily a very dangerous complication, if promptly dealt with on antiseptic principles. It is more likely to follow upon lacerations or contusions of the renal substance than upon incised wounds, whereas the latter bleed more freely but are less liable to suppuration. The form of injury most likely to be followed by pus-formation is wound by a bullet, and, as a matter of fact, in most cases where such a lesion has not proved fatal at once, suppuration has been free and prolonged.

In *disease* the same tolerance of change is noticed in the kidneys. So long as one organ remains fairly healthy, the other may be extensively affected before it makes any serious difference to the economy. It may be the seat of new growth, a stone, pyonephrosis or hydronephrosis or a tubercular deposit, and yet the patient may go on for a considerable time without any serious evidence of constitutional derangement. Indeed it is remarkable how much both kidneys may be damaged without interfering with the general system, provided parts of the organ remain sound. From these considerations, as well as from the facts recently collected from the experience of operations upon the organ and its removal, we may gather that the kidney, though an organ of much importance, is not so easily embarrassed in its functions by mechanical disturbance or morbid alteration of structure as has been hitherto commonly supposed; and further, that the organ possesses a vast excess of secreting and eliminative power beyond what it is usually called upon to put forth, and, consequently, may be deprived of this margin temporarily or even permanently, without much apparent injury to the system, so long as a proportion of its secreting tissue is left, sufficient for the ordinary uses of the economy. Thus, it has been shown experimentally on animals, and more recently by operation on man, that one sound kidney is amply capable of doing all the work of the body when the other has been removed; just as it had often before been shown by pathological study that even a single kidney, though itself seriously damaged, might still continue to carry on fairly well the work of the system, perhaps for years, after its fellow had been completely destroyed by disease.

But it should not be forgotten, in these days of renal surgery, that there are certain diseases which are prone to develop in both kidneys at or about the same time, and that the operator is called upon to exercise the greatest caution in regard to them. This is notably the case with Nephrolithiasis, the condition which, perhaps more than any in this region, is likely to require surgical interference. At the root of this disease is a general constitutional vice of digestion and elimination, whose expression is the deposit of crystalline matter in the renal tissues for want of proper solution, or, possibly, as the result of a local catarrhal condition besides. What takes place on one side, then, is very likely to take place more or less on the opposite sooner or later. The same may be said perhaps of tubercular disease, and of the forms of suppurative Pyelitis. A knowledge of these facts will, on the one hand, incline us not to postpone operation too long when we have reason to believe that the disease is still unilateral, and on the other will deter us from any officious interference where it has lasted a long time.

No notice of the surgery of the kidney would be complete without a brief sketch of the modes in which the organ should be examined. Such an examination ought to be conducted with the utmost care, so that the surgeon may have in his possession every fact it is possible to collect, before he thinks of interfering with so important a region. After a careful inquiry into the patient's personal and family history, we should proceed to learn what we can of the state of the kidneys by a general physical examination of the body, but specially by (*a*) palpation and percussion of the renal region, and (*b*) by an examination of the condition of the urine. Palpation should be conducted as follows:—One hand should be placed crosswise beneath the last rib, as the patient lies on the back, with the knees drawn up and the abdominal muscles relaxed. Then, the other hand is placed anteriorly just below the cartilages of the ribs, and pressed backwards to meet its fellow. In this way the lower third of the organ can be felt between the two hands, the upper two thirds being, as a rule in health, above the last ribs and out of reach. If the organ be enlarged by morbid change, and indeed sometimes in health, it lies lower and more internally than this, and can be readily felt. The larger it becomes, the more it descends and the nearer it approaches the umbilical region, and in some cases it has been felt even a little beyond the middle line of the body. By this palpation the position, size, shape, and consistence of the kidney may usually be made out if the patient be under the influence of an anæsthetic, as ought always to be the case if an examination is to be thorough. By careful percussion, on the other hand, the relation of the abdominal contents to the kidney will be established. The colon will always be found in front of or to the inner side of renal swelling, no matter how large the latter may be. If it be emptied of gas, however, this may not appear at once, though the fingers may feel a ridge, formed by the empty colon, running down over the front of the tumour. But even then it may be brought out clearly by inflation with air or slow injection of water from the anus, the patient's pelvis being raised for the time, during the percussion and manual examination of the abdomen. Again, if the surgeon have a slender hand and the patient be an adult, much information may be obtained as to the state of the kidney by passing the hand up the rectum, the patient being under chloroform. This can, however, only be done in certain cases, and should not be forced.

Finally, much insight may be gained into the nature of renal swellings by needle-puncture through the loin. The kidney can always be reached with safety by introducing a needle just below the last rib, and about 7 or 8 centimètres ($2\frac{1}{4}$ to 3 inches) from the middle line of the back. If the needle be now thrust inwards directly across the axis of the body and towards the spine, it ought to strike the lower end of the healthy kidney. But, as this manœuvre is rarely necessary for the examination of the organ when of normal size, the point chosen should be lower down—viz. between the last rib and the crest of the ilium, and the direction of the needle should be somewhat forwards and a little downwards—in short, as nearly as possible towards the umbilicus. This is the direction the writer has been in the habit of adhering to as a routine practice. It is always best in such an examination to use a fine aspirator needle about four inches long, by which much information may be obtained as to the nature of the tumour, and warning be given at once should a vessel of any size be punctured. The dangers of this exploration are insignificant, the operation being post-peritoneal if performed with care; the writer is not aware of any injury having ever been produced by it, and he has both seen it used by others and employed it himself in a large number of cases. With very large renal tumours, considerable latitude may be given to the direction of the needle, so long as it is entered behind and kept away from the vessels entering the hilus. Catheterisation of the ureter is a manœuvre which in some cases, if feasible, may yield important results. It is only possible in the female, and then only in a very few cases. The difficulty of introducing the long slender instrument into the vesical orifice of the ureter after passage up the urethra is so great, and in very many cases insurmountable, that it is not likely ever to come into general use.

Examination of the urine will embrace an estimate of its total amount for the twenty-four hours, for a series of successive days (normal 40 to 50 oz.); its specific gravity (1,015 to 1,025) on the gross amount; its reaction (acid); and the percentage of urea (2 per cent. to 2½ per cent. = 3 to 3½ grs. to every pound weight of the body of the adult, somewhat more for children). Further, it will include tests for albumen and sugar, and a microscopical search for elements of tissue and crystalline deposits. Again, much valuable evidence may be obtained by a careful and extended observation of the temperature of the body in the morning and evening. There are conditions of the kidney in which this record will be of special value, taken, of course, with other symptoms. They will be referred to under the several diseases.

Nothing but the most careful examination in all these directions ought to satisfy the surgeon; and it is only by the greatest watchfulness and the fullest consideration of all the data obtained that grave errors are to be avoided, especially where operations are in contemplation.

Arthur E. Barker.

KIDNEY, Tumours of the.—These may be classified for convenience' sake into fluid and solid. Of the fluid tumours the most common are Hydronephrosis and Pyonephrosis, the less common the cystic kidney and hydatid swellings.

Cystic Kidney seems to be produced by similar causes to those originating hydronephrosis, but probably operating in a different way. It appears to arise, usually, from obstruction of one kind or another to the escape of urine from the kidney, but probably of an incomplete or intermittent character. In some cases, the mode of production is almost impossible to discover. But what is most frequently found is obstruction, either of the ureter or of one or more calyces or of some group of renal tubules, due to the presence of calculous matter or some catarrhal condition, or both combined. This may produce changes extending over every part of the organ, or may affect only a portion of it. The retention of urine, due to this obstruction, dilates the parts behind the latter until a number of loculi are produced containing cloudy urine, or until the whole organ is converted into a cluster of sacs, varying from the size of a pea to that of an orange. With a moderate degree of cystic change a kidney will secrete freely and well; and, were the obstacle removed, would probably continue to yield urine of an average quantity and quality for an indefinite time. But, in extreme cases, so much interstitial change has taken place that secretion is most seriously interfered with, if not totally arrested. This has been learned from the operations, which of late years have become common for these conditions, leaving a fistula in the loin from which the urinary flow can be watched.

The symptoms of cystic kidney are in most cases very obscure, unless the condition give rise to a very distinct tumour, which is rare. We have to depend here upon local pain, usually of an intermittent character, often very severe, and upon traces of catarrhal products in the urine passed, and also upon the absence of evidence of other disease. But, in many cases, cystic kidney is found after death in persons who have never complained of any renal disorder. Fortunately for surgeons, the patients afflicted with this disease who seek their aid are usually suffering from renal calculus as an exciting cause, and have the characteristic pain and other evidence to guide them, and a definite evil to remove.

The *treatment* is the same as for renal calculus. In other words, if a stone is found on exploring the organ through a lumbar incision, it is to be removed; but if the source of obstruction is not found, and the suffering be severe and the cystic change far advanced, the organ should be removed, provided there is evidence that the opposite kidney is sound. It would be better probably to do this as a secondary operation in all cases, and only after patient trial of drainage through the loin; for in some cases the latter has been found to relieve and even cure the pain, and, on the other hand, the question as to the state of the opposite kidney is always a most difficult one to decide. *See* Nephrolithiasis.

Hydatid Cysts of the kidney are very rare, and need only be alluded to here so far as to say that the symptoms will be those of a fluid tumour of the kidney (*see* Hydronephrosis), together with the extra evidence to be obtained by aspiration of the tumour in the loin, and examination of the fluid removed for hooklets, &c. The urine passed *per urethram* will also in some cases contain the latter.

The *treatment* for hydatid disease of one kidney alone would be free incision through the loin into the sac, and removal of its contents and cyst wall, with free drainage of the resulting cavity.

Among the primary *solid tumours* of the kidney are nearly all the neoplasms—if we include under this term syphilitic and tubercular deposits, as is often done. Thus we find sarcomata, carcinomata, lipomata, angiomata, rhabdomyomata or tumours containing striped muscle-fibres, also some curious heterotopic growths formerly supposed to be lipomata, but now recognised as derived from fragments of the supra-renal capsule included in the kidney-substance during its development, which have taken on new growth at a later period of life. In the pelvis of the organ we also find papilloma, and, in any part, syphilitic gumma and tubercular deposit. These new growths are met with at all ages from infancy upwards, and apparently with equal frequency in both sexes. It is a point of some interest to note that, with the exception of the papillomata, syphilomata, and tubercular deposits, all the new growths appear to originate in the cortex and to spread inwards towards the pelvis. The sarcomata are mostly of the small-celled, soft, and vascular variety, and bleed readily; the carcinomata are also very soft, and cause hæmaturia in many cases; the same may be said of the papillomatous and tubercular masses. All the others as a rule do not bleed. It should be remembered here, as an important point bearing upon the question of operations on the kidney, that the new growths of the organ appear to limit themselves for a long time to it alone, and do not readily infect either surrounding tissues or the adjacent glands or circulation. They sometimes attain enormous size without any sign of generalisation anywhere.

The *diagnosis* of these tumours is based upon the same general considerations which guide us in their diagnosis elsewhere. We have, indeed, few special indications to help us except the state of the urine. Here, in the case of the sarcomata, carcinomata, and papillomata, we may find blood and, as in one of the writer's cases, shreds of the tumour; and, in the case of the tubercular kidney, there may also be hæmaturia, and, besides, a purulent sediment with shreds of caseous matter. But of the presence of the other growths no special signs are known. In all cases the history, both personal and family, must be carefully made out; then the duration and nature of the symptoms; then the urine be carefully examined, both before and after palpation of the tumour; finally, much information may be gained by careful puncture of the mass from behind, at the point of election, with an aspirator needle, and examination of the material withdrawn.

As to the *treatment* of these new growths, further study is required before definite rules can be laid down. But enough has already been learned to point to the conclusion that, with a clear history of malignant tumour, an exploratory incision should be made as early as possible, and if a growth be found, that it should be removed by NEPHRECTOMY. Many cases are on record in which this has been done successfully, and many more in which the want of success has been due to delay of the operation until matters had gone too far. For the benign tumours little treatment is ever called for; they often give no sign of their presence during life. ARTHUR E. BARKER.

KNEE, Diagnosis of Affections of the. *See* THIGH AND LEG, Diagnosis of Affections of the.

KNEE, Dislocations of the.—Although the bony surfaces of the knee-joint offer little impediment to dislocation, the ligaments holding together the bones are so strong that complete dislocation is very uncommon, except as the result of disease, and partial displacements are far from frequent.

Dislocation may take place *outwards*, *inwards*, *forwards*, *backwards*, and by *rotation outwards*. The lateral dislocations are incomplete; the forward and backward may be either complete or incomplete.

Partial dislocation outwards of the tibia is the most frequent accident, and may be caused by a weight striking the outer condyle when the limb is extended, or by an outward fall when the leg is caught in a hole. The outer condyle rests on the inner articular facet of the tibia, the inner condyle projects internally, and the outer tuberosity of the tibia and head of the fibula form a prominence on the outer side of the joint. A certain amount of rotation outwards of the leg usually accompanies this injury. *Reduction* is easily effected either by flexion or extension, combined with pressure, and an ice-bag or Leiter's coil should be applied to allay inflammation, after which the joint should be kept on a splint for a month to allow time for the reunion of the ligaments. After this, a knee-support should be worn for some months. There is a rare accident with which this dislocation may be confounded, viz.: oblique fracture of the outer tuberosity of the tibia with fracture of the fibula, caused by a jump from a height on to the feet.

Partial dislocation inwards is usually caused by a fall on the outer side of the leg, the limb being bent under the body. The inner tuberosity of the tibia forms a prominent tumour immediately beneath the skin on the inner side, whilst the external condyle of the femur projects externally. The internal saphenous vein is liable to be injured by the displaced tibia. *Reduction* is easily effected by pressing the tibia outwards, at the same time that the foot is drawn inwards.

Dislocation forwards gives rise to very great deformity, and, when complete, the tibia may be forced up on the femur to the extent of two to four inches. It may be caused by some force striking the front of the femur when the leg is fixed, or by a heavy weight falling from the shoulders and striking the calf of the leg, whilst the person is stooping. The tibia forms a distinct prominence anteriorly, whilst the condyles of the femur project into the popliteal space, stopping pulsation in the artery and giving rise to great pain by pressure on the nerves. The dislocation is usually easily *reduced* by extension, after which it is necessary to keep the knee at rest for a month or six weeks. Passive motion should then be employed, and the knee be supported for some months in a leather cap.

Dislocation backwards is about half as frequent as dislocation forwards. The tibia projects into the popliteal space, compressing the vessels and nerves, and the condyles of the femur ride forward. The limb is usually found in a state of over-extension, and the patella lies with its surfaces horizontal beneath the projecting femur. *Reduction* can be effected by the surgeon fixing the foot with his knee in front of the ankle, and then clasping his hands behind the displaced head of the tibia, and drawing it downwards and forwards into a state of flexion. Should this method fail, ordinary extension may be tried. The after-treatment will be same as in the other forms.

Dislocation by rotation outwards is very rare. The tuberosities of the tibia are directed antero-posteriorly, and the patella projects on the outer side, whilst the inner surface of the leg is directed forwards and the fibula backwards. *Reduction* is to be effected by first making extension, and then twisting the leg inwards.

Congenital Dislocations are usually forwards.

Compound Dislocations as a rule necessitate amputation of the limb.

R. Clement Lucas.

KNEE, Excision of the. *See* Joints, Excision of.

KNEE-JOINT, Amputations at the. Disarticulation at, or amputation through the knee-joint, although alluded to and performed by the older surgeons, including Hildanus, Hoin of Dijon, J. L. Petit, Blandin, and Brasdor, did not find general acceptance until Velpeau, in 1829, strongly advocated the procedure, which he carried out by a circular amputation four fingers' breadth below the patella. Even then, it had but a short-lived popularity until Malgaigne expressed his emphatic opinion that it had been too soon abandoned, having regard to its special advantages in facilitating the movements of the hip-joint. His advocacy was supported subsequently in America by Smith, Markoe, and Brinton, and in England by Holmes, Pollock, and others. The advantages mentioned by Markoe are —(1) the slight shock attending the operation; (2) the limited section of the tissues; (3) the non-exposure of the muscular interspaces and the consequently diminished risk of suppuration in the thigh; (4) the comparatively few vessels requiring ligature; (5) the attachments of the thigh muscles being mainly preserved; (6) the absence of muscular retraction; (7) the diminished risk of osteo-myelitis and exfoliation, from the femur not being sawn across; and (8) finally, the useful character of the resulting stump. In spite of these advantages, the operation, owing to the irregular surface of bone on the face of the stump, the alleged liability to exfoliation of the cartilage of incrustation, and the high mortality, fell again into disfavour.

The next procedure adopted was the operation, recommended by Syme, through the condyles of the femur, but with a short anterior and long posterior flap taken from the calf of the leg, almost similar to the flaps made by Hoin in amputation through the knee-joint. The long posterior flap is, however, an obvious disadvantage. Hence Carden introduced a modification, dispensing with the posterior flap and substituting a long anterior skin flap. Carden's modification, which possesses many advantages, is still frequently performed. 'The operator, standing on the right side of the limb, seizes it between his left forefinger and thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round, through skin and fat, below the patella, to the spot pressed by his thumb; then, turning the edge downwards, at a right angle with the line of the limb, he passes it through the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards and the saw applied.' This operation, however, has two defects—(1) the danger of sloughing of the anterior flap, and (2) of a large gaping wound, owing to the tendency to retraction of the posterior tissues. These defects are to a great extent remedied by Gritti's operation, which consists in a somewhat square-shaped or rectangular flap taken from the front of the knee, retaining the patella, the femur being divided on a level with the condyles. In addition, the cartilaginous surface of the patella is removed, and the patella and the cut surface of the femur are placed in apposition, in the hope of bony union taking place. This operation suggests Pirogoff's amputation transferred to the knee-joint.

But in Gritti's operation there is a difficulty to be overcome—that of keeping the patella and the cut surface of the femur together. With this object, the writer has suggested a higher femoral section—namely, at a point from half to three-quarters of an inch *above* the antero-superior edge of the cartilage of incrustation. This point is selected, as a femoral section lower down inevitably leads to the tilting forward of the patella during the healing of the wound; and, on the other hand, were the section made higher than the point indicated, the medullary canal would be opened with increased danger to the patient; besides, the risk of the split patella hanging down at a lower level than the cut surface of the femur would be present. The femoral section being well above the condyles of the femur, the writer has suggested that this modification of Gritti's amputation be designated 'supra-condyloid.' Its steps may be briefly described:—The anterior flap, not rectangular, but oval, should reach from a point one inch above either condyle to the other, and thence downwards below the tubercle of the tibia. A posterior flap, at least one-third the length of the anterior flap, should also be formed, since the posterior tissues retract so much more than the anterior. Unless the flap be made in the situation indicated, there is the risk of a gaping wound, as in Carden's and Gritti's operations. By suturing the two bones together and leaving the sutures in the wound, displacement of the bones is effectually prevented, and the chances of bony union largely increased, while the condition most favourable to fibrous union exists.

The special advantages of the supracondyloid amputation are:—(1) The posterior surface of the anterior flap is furnished with a natural synovial lining, which largely diminishes the risk of exhaustive suppuration and purulent absorption. (2) By suturing the bones together, as described, the possibility of the split patella shifting from its place on the cut surface of the femur is prevented. (3) The osseous curtain, formed by the split patella covering the surface of the femur, lessens the risk of pyæmia and sloughing, as in the case of the periosteal curtain recommended by Von Langenbeck. (4) The vessels are divided at right angles to their continuity, instead of obliquely, as in other flap operations. (5) The posterior flap lessens the risk of a gaping wound posteriorly. (6) The diminished liability to tubular sequestra. (7) Only one large artery requires ligature. (8) There is less of shock than in the higher amputations, the divided muscles being few, and cut, not through their fleshy bellies, but at their tendinous extremities. (9) There is less liability to suppuration. (10) The medullary membrane not being interfered with, there is less liability to osteo-myelitis. (11) The preservation of the normal attachments of the extensors of the leg.

In suturing the bone, wire or chromicised catgut should be used. Having had in his earlier experience to deal at times with serious hæmorrhage from the popliteal vein, the writer now ligatures that vessel with chromicised or carbolised catgut, and no such trouble has since ensued. The cases for which this method of amputation is most suitable are—(1) Fractures of the leg necessitating amputation, in which the injury to the soft parts extends high up; (2) extensive necrosis, or abscess of the head or upper third of the tibia; and (3) cases of malignant growth, in which the removal of the whole leg is expedient.

William Stokes.

KNEE-JOINT, Diseases of the.—The knee-joint, from its prominent position, mobility, and active function, is peculiarly prone to disease.

Acute synovitis is very common in the knee, and is usually of *traumatic* origin. The swelling of this joint is obvious;

it reveals the outline of the synovial reflexions, making a rounded prominence over the lower end of the front of the femur, and bulging on either side of the patella. Fluctuation is easily felt from side to side, and the bulging is increased by pressing back the patella, which is thrust forward by the fluid, and can be made to 'rap' against the femur. The increased temperature of the joint can also be easily felt by the hand. Movement will be resisted and the joint fixed in the slightly flexed position, by the rigidity of the surrounding muscles.

If the synovitis be of *rheumatic* origin, other joints will probably be affected, and there will be, in addition, the general symptoms of rheumatism. It often happens however, that inflammation persists in one joint after the subsidence of the fever and the recovery of the other articulations, and the knee is especially liable to be the joint selected. Synovial effusion persists or recurs, and, when the swelling is removed, the joint is left stiff by adhesions both within and around the joint.

Pyæmic synovitis frequently attacks the knee, and in the acute form usually leads to rapid and destructive suppuration. The occurrence of suppuration is indicated by increase of the constitutional disturbance, and by the presence of œdema along the sides of the condyles of the femur and the head of the tibia.

The first essential in the *treatment* of all acute inflammations of the knee is to ensure perfect immobility of the joint. A splint must be applied, extending to the upper part of the thigh and including the whole of the leg and foot; and to this the limb is to be bandaged in a position of slight flexion. A McIntyre's splint is a convenient form, but whatever kind of splint is used must have a foot-piece, and include the whole limb as far as the upper fourth of the thigh. In many cases much comfort is given by swinging the limb, as in a 'Salter's cradle.' In the early stage of synovitis the joint may be leeched, or cold applied; and when the acute symptoms have subsided, blisters and pressure are useful.

When suppuration is suspected, the nature of the effused fluid is to be ascertained by aspiration, and, if pus is present, the joint must be freely laid open by an incision on each side of the patella, as far back as possible, so as to thoroughly drain the cavity.

Subacute synovitis, leading to hydrops articuli, is more commonly seen in the knee than in any other joint. The joint is weak, and bulges in all directions from the contained fluid. If blistering or pressure by an elastic bandage or strapping does not remove the fluid, the joint must be emptied by aspiration, and pressure be afterwards maintained; and if it again fill, an injection may be used, such as a 1 per cent. solution of carbolic acid, or a mixture of tincture of iodine and water, 1 to 10 or 20. An elastic knee-cap must be worn afterwards. *See* HYDRARTHROSIS.

Recurrent synovitis in the knee is sometimes due to adhesions within the joint, in which case movement will be restricted, and perhaps painful, in certain directions. The adhesions are to be ruptured by sudden flexion during anæsthesia.

Chronic synovitis of the knee-joint is commonly met with in the form of pulpy degeneration, giving rise to an indolent elastic swelling of the synovial tissue, and leading eventually to ulceration of the cartilages and softening of the ligaments. After a time, displacement of the bones occurs, the tibia being drawn backwards and rotated outwards and the limb flexed, so that the articular surface of the femur projects in the front of the joint, and the patella rests on the outer condyle.

Scrofulous disease of the knee may commence thus, or, as is more commonly the case, in a chronic articular ostitis. In either case, the disease makes very indolent and slow progress, the products of inflammation showing an early tendency to degenerative changes, so that the synovial membrane, having first become thickened and pulpy, slowly caseates or suppurates; or the expanded joint-ends of the femur and tibia gradually undergo central softening, and ulcerate either in the direction of the surface or into the joint. These changes are accompanied by but little pain or pyrexia.

At the commencement of chronic disease of the knee-joint, the limb must be at once fixed upon a splint; if there be any considerable heat or pain about the joint, perfect rest must be enjoined, but if these be slight, a well-fitted leather splint, or a Thomas's splint, may be applied, and the patient allowed to get about on crutches and with a thick sole to the boot on the sound limb. Every possible attention must be paid to the general health and to improving the reparative power; while, at the same time, local counter-irritation may be effected by the cautery or repeated small blisters, and followed by strapping over mercurial ointment.

In more advanced cases of synovial degeneration, in young subjects, the pulpy tissue may be scraped or dissolved away through lateral incisions made on each side of the patella. A Volkmann's spoon should be used for scraping out the diseased membrane; sulphuric acid diluted with two parts of water may be used for its solution. The remaining alternatives are excision or amputation.

If the disease commence in a chronic ostitis of the end of the femur or head of the tibia, symptoms of suppuration must be carefully watched for, and any indication of the presence of matter within the cancellous tissue must be followed by perforation of the bone, to endeavour to obtain its exit upon the surface rather than into the joint. It is not uncommon in performing excision of the knee to find, on making the section of the tibia, the cavity of an abscess from which matter has made its way into the joint. If such a cavity does not extend far from the joint surface, it may be scraped out, and a satisfactory ankylosis may still be obtained; but if the bone be extensively softened or carious, amputation will be necessary. The same may be said of abscess in the end of the femur.

Syphilitic disease of the knee is met with, both as a synovial effusion accompanying the secondary stage, and also as a gummatous infiltration of the synovial membrane, or of the sub-periosteal or other tissues around the joint.

The joint must be kept at rest during the administration of antisyphilitic remedies, and under these the secondary synovitis usually subsides. The tertiary disease often leaves much stiffness from thickening and cicatricial contraction, both within and without the joint. This form of disease is also met with in inherited syphilis. In addition to the constitutional treatment, shampooing, passive movements, and friction with oleaginous liniments must be resorted to.

The knee is one of the joints most frequently the seat of *osteoarthritis*, the symptoms of which are usually easily recognisable. There is a moderate amount of synovial effusion, marked and often loud crepitation on movement, and alterations in the shape of the ends of the bones, obvious both to sight and touch. Much lameness results, and sometimes much wasting of the muscles of the thigh and leg. The disease may be retarded and ameliorated, in its earlier stages, by treatment directed to the correction of rheumatic tendencies, and by the local use of warm douches and frictions; the joint should be supported, as by a flannel bandage, but not fixed; and unless there be much or increasing swelling, moderate use of the limb may be permitted.

Loose cartilages, though occasionally met with in other joints, are found chiefly in the knee, wherein their presence is the more obvious because of the grave inconvenience to which they give rise. The anatomical structure of the joint and its free movement make it especially easy for the loose body to slip between the ends of the bones; this gives rise to acute pain, and may cause the patient to fall. Recurrent synovitis is set up, with increasing weakness of the joint, and the usefulness of the limb is materially impaired. The body can be pushed to the surface of the joint and felt through its coverings. Sometimes it is pedunculated, and its movements therefore restricted to one part of the joint. Loose bodies are often multiple.

If the patient be in good health the loose cartilage is best removed by direct incision of the joint, with antiseptic precautions. If this be not desirable, attempts should be made by strapping and bandaging to fix the loose body in one part of the synovial sac, and an elastic knee-cap be worn to restrict movement and support the joint. *See* Loose Cartilages.

J. Warrington Haward.

KNOCK-KNEE. *See* Genu Valgum.

KOCHER'S OPERATION. *See* Tongue, Operations for Removal of the.

KYPHOSIS. *See* Antero-Posterior Spinal Curvature.

L

LABIA PUDENDI. *See* Vulva.

LABYRINTH, Affections of the. *See* Ear, Internal, Diseases of the.

LACRYMAL APPARATUS, Diseases of the.—Acute Inflammation of the Lacrymal Gland, or of the connective tissue immediately surrounding it, is acknowledged by all observers to be of rare occurrence. The local signs are redness, heat, pain, swelling, and disturbance of function. In some cases, the secretion is greatly increased in quantity; Schmidt, for example, stating that he collected by means of a sponge, in the course of twenty-four hours, no less than two pounds seven and a half ounces of fluid. In other instances it is diminished. The globe of the eye is pushed downwards, or downwards and inwards, and its movements are interfered with, so that diplopia results. Vision is not, however, materially lowered, because the elasticity of the optic nerve permits some stretching to take place without impairment of function. Intolerance of light and spasm of the lids have been occasionally noticed.

The process of suppuration in the lacrymal gland is attended with considerable disturbance of the general health. The swelling remains for some time hard and resistant to pressure, owing to the dense tissues surrounding it. It is limited to the outer part of the orbit and eyelid, and in the course of ten days or a fortnight begins to soften, and may point either in the conjunctival sac or on the skin near the margin of the orbit. The pre-auricular lymphatic gland is sometimes swollen. The treatment consists in the application of leeches, irrigation with cold water, purgation, and general antiphlogistic measures. Owing to the deep situation occupied by the gland, the abscess, if allowed to burst spontaneously, is apt to leave a fistulous tract behind it. It should therefore be opened freely as soon as fluctuation is perceived. The incision should be made parallel with the margin of the orbit and the fibres of the orbicularis muscle. A drainage-tube may be introduced.

Chronic Inflammation of the Lacrymal Gland is also of rare occurrence. The symptoms resemble those of the acute form, but are more subdued. The formation of a fistula is not infrequent. Where this unfortunate event has taken place, attempts may be made to effect its cure. The most effective method consists in threading two needles with a piece of fine silk. One of the needles is then introduced through the external orifice, and made to travel for some distance up the fistulous passage before perforating the conjunctiva; the other needle is carried through the conjunctiva close to the cutaneous orifice of the fistula. On tying the two ends of the silk together, a portion of the conjunctiva is enclosed in the loop, which on cutting its way out establishes a new opening for the tears. After the edges of the fistula have been freshened, and brought together with a suture or two, the cutaneous passage closes. Another method consists in heating to redness, by means of a galvanic battery, a wire, which has been introduced into the fistula.

Chronic Enlargement of the Lacrymal Gland may be due either to simple hypertrophy of the gland-tissue, or to the formation of such benign tumours as adenoma, fibroma, myxoma, and chondroma; or lastly to the gland becoming the seat of the malignant and recurrent tumours known as round-celled and spindle-celled sarcoma, which usually occur in children, carcinoma and epithelioma, which are most common in old persons. In several of these forms of disease cysts and partial colloid degeneration may supervene. Cases of syphilitic disease of the lacrymal gland have been recorded by several observers; one by Mr. Streatfeild was cured by the use of mercury and iodide of potassium. It is very difficult to diagnose a chronic enlargement of the lacrymal gland from a node, and it is probable that the two affections have sometimes been mistaken for each other, especially as both may proceed from the same cause, and may both disappear under the same treatment.

Extirpation of the Lacrymal Gland. The lacrymal gland consists of two parts, one superior, the other inferior and in close relation with the conjunctiva. If the upper or larger mass alone require removal, it is sufficient, in prominent eyes, to make a cut through the skin just below the eyebrow, parallel to the margin of the orbit, and, in deep-set and low-browed eyes, to shave the hairs and divide the skin along the middle of the eyebrow for the space of an inch and a half. The depth at which the gland is situated is considerable, and the dissection must be continued till it can be seized with vulsellum forceps and drawn down. A little manipulation with the handle of the scalpel will then effect its removal. When the gland is greatly augmented in size, or when both parts have to be removed, the palpebral fissure may be enlarged by a cut made towards the temple from the external canthus. The small branches of the facial artery which are divided should be tied, and the upper lid can then be dissected up till the gland is exposed, when it may be seized and removed as before. Mr. Z. Laurence, who extirpated the gland on several occasions, not only enlarged the palpebral fissure in the manner just described, but made a cut below the eyebrow, which was continued till it met the first incision at an acute angle. The triangular flap thus made was dissected back towards the nose, till the gland was exposed.

Obstruction of the Canaliculi.—The orifice of one or other of these minute tubes is sometimes occluded by a delicate pellicle, which may be broken down with facility by the pressure against it of a sharp-pointed probe or a breast-pin. It appears to be a congenital defect when the opening is obstructed in this or any other manner. The tears collect at the inner corner of the eye, and, if not wiped away, from time to time trickle over the margin of the lid and down the cheek, which they redden and excoriate. This condition, which is named *Epiphora*, is especially marked on exposure of the eye to cold winds, bright lights, and after food, and during any mental excitement occasioning congestion of the vessels. In such cases there is usually some redness of the conjunctiva, both ocular and palpebral. A little puriform mucus appears in the conjunctival sac, and the lids stick together during sleep. When these symptoms have suddenly appeared, a careful inspection should be made of the puncta lacrymalia with a hand lens. An eyelash or other foreign body may sometimes be discovered, the removal of which at once relieves the symptoms. Small dacryoliths, and occasionally accumulations of leptothrix, have been observed to occlude the canaliculi. As a rule, they require removal by an incision. Occlusion of the canaliculi is often the result of burns, lacerations, and surgical operations performed upon the lids, as well as of the development of polypi. In the former cases, efforts should be made to restore the patency of the canal, which may sometimes with care be effected.

Deviation of the Puncta.—It is of great importance that the puncta should occupy their normal position. If the margins of the eyelids are turned inwards, they become applied to the globe of the eye; if outwards the fluid cannot enter these orifices, and in either case epiphora results. The conditions leading to deviation of the puncta are very various. In old people eversion of the lower lid is often attributable to mere relaxation of the skin and loss of power of the orbicularis muscle. It may also be due to paralysis of the facial nerve, a condition that has been observed in infants as the result of the employment of forceps in delivery. Such cases are commonly incurable, and removal of the lacrymal gland holds out the best prospect of improvement. Thickening attended with some eversion of the lids is a frequent result of ciliary blepharitis; and when this is ascertained to be the cause, the conditions which have led to the inflammation of the lids should be carefully studied, attention should be paid to the refraction of the eye, and appropriate local and general measures be adopted, before resorting to any of the operative measures which are about to be described. See *Blepharitis Ciliaris* under Eyelids, Diseases of the.

Mucocele or Chronic Dacryocystitis. This condition is usually but not necessarily associated with epiphora—that is to say, where mucocele exists there is almost always epiphora, but epiphora may exist without mucocele. It is probably, in most instances, the result of antecedent inflammation of the sac.

The symptoms are those of a smooth, rounded, or oval tumour presenting itself at the inner angle of the eyelids in the position of the lacrymal sac. It is often bilobed in consequence of the position of the ligamentum palpebrale internum, which crosses the sac at right angles, and binds it down near its centre. It is painless and tense, though possessing a considerable amount of elasticity. In some instances no impression can be made upon it by pressure, whilst in others it may be partially or completely emptied, the contents either altogether passing down the nose, or being regurgitated through the canaliculi and puncta into the sac of the conjunctiva. Not infrequently it flows in both directions. The fluid which regurgitates is at first clear, thin, and transparent, as though composed of tears alone, but almost immediately becomes thick and glairy, and if the pressure be continued puriform mucus is usually discharged. The flaccid sac can then be felt. In most instances the conjunctiva, especially near the inner angle of the eye, is red and inflamed, and not infrequently pustules appear on the margins of the lids; whilst, in a large proportion of cases, the epithelium of the cornea at the sclero-corneal junction may be detached, a condition which may develop into an ulcer of considerable depth with whitish slimy base. According to Panas, in the healthy state the membrane of the sac secretes a glairy fluid, in which columnar epithelial cells destitute of cilia may be seen with the aid of the microscope. In disease, lactescent striæ appear in the fluid, which at first sight look like pus, but which are only accumulations of mucus-globules, resembling those met with in the fluid secreted from other inflamed mucous membranes. It is only when the inflammation has attained a certain degree of intensity and has become the seat of an epithelial exfoliation or ulceration, that the contents of the sac become really purulent. In some instances, small plates of cholesterine are to be found in the fluid. In the early stages of chronic inflammation of the lacrymal sac, the membrane is either uniformly reddened or presents patches of congestion. After some time it becomes thickened and soft, bleeding freely when touched; and it is stated by those who have laid the sac open—an operation now rarely performed—that the mucous membrane presents a villous aspect, with rugæ that must greatly tend to occlude the passage.

At certain points constrictions are apt to occur, the most common site being the point where the lacrymal sac becomes continuous with the nasal duct, the next the point of entrance of the canaliculi into the lacrymal sac, and perhaps the next the inferior orifice of the nasal duct. In the dissection of a lacrymal fistula which had existed twenty-two years without treatment, A. Voisin found that the common opening of the two lacrymal ducts into the lacrymal sac was obliterated; the sac when empty and retracted presented friable walls. There was a complete obstruction at the point of junction of the sac with the nasal duct. In some instances, the lacrymo-nasal passage has been observed to be constricted at the point where the sac is continuous with the nasal duct; in others the mucous membrane of the sac has been found to be of a vivid red colour, with considerable thickening of its walls; in others the sac has been found to be filled with a polypoid growth.

In regard to the etiology of chronic dacryocystitis, it is generally acknowledged to be associated with signs of strumous diathesis. The patients are often soft and flabby, with dull turbid complexions, and are subject to chronic inflammation of the eyelids and of the mucous membrane of the nose. In such cases the course of the disease is easy to read. The inflammatory process, affecting the Schneiderian membrane or the conjunctiva, spreads by contiguity up or down the naso-lacrymal passage. The secretion of mucus is augmented and, gravitating towards the bottom of the nasal duct, the orifice of which may be congenitally small and is now still further reduced by the general swelling of the mucous membrane, plugs and occludes it, or at all events renders the passage of tears very difficult and slow. The conditions now react on each other. The mucus and tears accumulating, still further distend the sac and increase the congestion, and the state of the whole sac and its contents is ripe for an explosion of acute inflammation, which may readily be excited by a slight blow, by the entrance of some septic matter, by cold or, possibly, even by disease of the adjoining bones caused by the long-continued pressure. Badal is of opinion that errors of refraction play an important part in the production of disease of the lacrymal organs. The error is as a rule moderate, and is on the side of hypermetropia.

In some instances of mucocele, however, a totally different condition of disease is present, and we have to deal, not with a constriction of the lacrymo-nasal passage, but with the growth of a cyst in the lacrymal sac. In such cases, the tumour may for a time only partially occlude the duct, and digital pressure over the sac may cause some fluid to regurgitate into the conjunctival sac and some to descend into the nose; but, after emptying it as thoroughly as possible in this way, there still remains a swelling which cannot be dispersed by pressure, and at a later period, when the cyst has grown sufficiently to fully occupy the sac and to distend its walls, no fluid will escape even when the pressure is very firmly applied.

If left to itself, chronic inflammation of the lacrymal sac has a strong tendency to induce caries and necrosis of the bones surrounding it. In some instances there are outgrowths from the bone itself, which may be painful or indolent; in others there is thickening of the periosteum, resulting from specific periostitis; in others, again, some portion of the lacrymal bone or ascending process of the superior maxillary is carious or necrosed. The writer has seen one case in which the frontal sinuses were filled with thick muco-purulent fluid, and in which there was caries of the ascending process of the superior maxillary bone and perforation of the palate-bone. A cure was effected by slitting up the canaliculus and passing the large end of Weber's probe, making a deep incision in the palate and removing some sequestra, and the sedulous use of antiseptic injections. There was no history of syphilis in this case, nor the slightest suspicion of such disease having existed. Many cases have been reported, however, in which the caries and necrosis of the facial bones have followed syphilis, and its pre-existence would certainly modify the treatment to some extent.

Treatment.—The different methods suggested may with advantage be considered under the following heads:—1. The prevention of the flow of tears. 2. The obliteration of the lacrymo-nasal passages. 3. The restoration of the patency of the lacrymal passages; and, lastly, 4. The formation of new passages for the discharge of the tears.

1. The prevention of the secretion of tears can only be accomplished by tying the ducts of the lacrymal gland, as recommended by Sedillot, or by the removal of the lacrymal gland, an operation that has been recommended and practised by P. Bernard, Z. Laurence, and Tavignot. The method of performing it has already been described.

2. The proceedings for the obliteration of the lacrymal passages include the obliteration of the puncta, the excision of the lacrymal sac, the laying open and cauterisation of the sac.

3. The methods for restoring the patency of the lacrymal passages consist in the employment of injections, and the gradual or rapid dilatation of the ducts, with or without antecedent slitting up of one canaliculus.

4. The operations for making a new passage consist in perforating the os unguis with the object of allowing the tears to drain into the nose, or in establishing a communication with the maxillary sinus.

It may be laid down as a general rule in the treatment of chronic dacryocystitis and mucocele, that the simpler measures should be exhausted before resorting to cutting instruments and the passage of probes. These, especially in unskilful hands, and sometimes even in the hands of those who have had considerable experience, do infinite harm. It is exceedingly difficult to make the finer probes pass down the lacrymal sac and nasal duct, even in the perfectly normal eye. They can readily be made to traverse the whole length of the canaliculi, but beyond this point they are apt to become entangled in the folds of the mucous membrane, and the slightest pressure makes blood appear—a sure proof that the membrane has been perforated and a false passage made; and if this be true of the normal eye, how much more difficult is it likely to be when the membrane is swollen, congested, and softened from disease? In such cases bleeding invariably occurs, and sometimes, it is to be feared, the bone is perforated and broken in the vain attempt to pass a probe in a wrong direction. Then, again, the operation of slitting up the canaliculus, whilst allowing the passage of larger probes with ease, and enabling strictures of the nasal duct to be dilated, is yet by no means always successful, and gives but small assistance when dead bone can be felt. In making the section, it is certain that parts of great importance from a physiological point of view are divided, since it not infrequently happens that, although probes of large size can be passed with the utmost facility through the aperture thus made into the sac and down the nasal duct, the flow of tears is as troublesome as before; apparently because the exhausting or compressive action of the fibres of Horner's muscle or of the orbicularis muscle upon the fluid in the lacus lacrymalis has been destroyed.

It is well, therefore, to commence the treatment of mucocele, especially if the sac can be emptied and its contents discharged into the nose by moderate pressure with the finger, by resolvent local and general remedies. The surgeon may assure himself of the patency of the puncta and canaliculi by the careful and slow passage of a No. 1 or 2 of Bowman's probes, injury to the parietes being avoided as far as possible, since it is certain to increase the evil and perhaps to induce an attack of acute inflammation of the lacrymal sac.

Hot poultices, and especially the application of dry warmth in the form of bags of heated chamomile flowers, hops, or bran, are often of great service. The injection of water or of some medicated solution, by means of a fine Anel's syringe introduced a little way into the canaliculus, may then be tried. The best collyria to be injected are a 5 per cent. solution of boracic acid, and weak solutions of iodine, alum, copper sulphate, and potassium iodide; or a small quantity of an ointment composed of one grain of atropine sulphate, five grains of mercury binoxide, and one ounce of vaseline, may be inserted between the lids. Good results are stated to have been obtained by blowing iodoform into the canaliculus and lacrymal sac. An examination should, in every case, be made into the conditions of the mucous membrane of the nose, as it is not improbable that some cases of chronic dacryocystitis proceed from extension of inflammation in that region, and that, by the cure of the primary affection, the state of the lacrymo-nasal passage may be improved or at least rendered more amenable to treatment. At the same time attention should be paid to the health. The general and dietetic regimen for struma and scrofula, with which the disease is so often associated, should be insisted on; and cod-liver oil, quinine, iron, warm or cold salt-water baths, country air and the removal of the depressing influences of late hours, excessive smoking, and the abuse of alcohol, are important points in the treatment.

When these measures fail, and it is clear that some obstruction exists in the lower part of the lacrymal sac or nasal duct, the passage of a probe must be attempted and dilatation effected.

With this object in view, fine probes may be passed down the canaliculi and the lacrymal sac, the diameter of the probes being gradually increased until the largest that can be made to enter the puncta have been introduced. If still no passage can be obtained, the canaliculus of the upper or lower lid may be divided for a part of its length, which allows the entrance of a larger probe and the more easy application of injections. In the event of this proceeding failing, it is expedient at once to proceed to perform the operation of slitting up the canaliculus along its whole length, which was originally proposed by Sir William Bowman. Since the inferior canaliculus is the most important in the process of draining off the tears, it is prudent to attack the superior canaliculus, which has the advantage of being in a more direct line with the sac, and thus permitting the passage of a probe, after its division, more easily.

The Method of Bowman.—This plan of treatment has the great advantage of enabling the surgeon to deal directly by means of large probes with strictures of the nasal duct or lower part of the lacrymal sac, without making any unsightly wound in the face. It consists in introducing through the superior or inferior punctum lacrymale and along the corresponding canaliculus a sharp-pointed small probe, which is grooved for about half an inch from the extremity. As soon as the point has entered the lacrymal sac, and is felt to touch its inner wall, it is withdrawn for a short distance, and either a probe-pointed knife or a Graefe's linear or other narrow-bladed knife is placed in the groove of the probe, which is turned towards the free surface, and is made to traverse a part or the whole of its length. By this means the canaliculus is slit up and converted into a groove or channel, and a straight or slightly bent probe can now be often at once passed down the nasal duct, breaking down or distending any obstruction that may have prevented the passage of the tears. The quantity of blood lost is sometimes very small, but occasionally the hæmorrhage is sharp for so small an operation, in consequence of the division of the angular artery. It is requisite to separate the lips of the little wound with a probe for one or two mornings after the operation, to prevent union from occurring. Some operators, with the same object in view, remove a small strip of the posterior edge of the wound with scissors, or touch the wound with oil or glycerine for a day or two.

In cases of simple obstruction, the passage of a moderate-sized probe through the nasal duct is sufficient to effect a cure; but when the bone is carious or necrosed, it is advisable to introduce a style, which is a straight piece of silver of the thickness of an ordinary dressing probe, and about an inch and a half in length. One end is smoothly rounded off, the other is enlarged into a head, or is sometimes bent like the handle of a walking-stick, to prevent its slipping into the dilated sac, an accident that has not infrequently occurred, though without serious consequences. The style may be worn for several days, being removed each morning in order to be cleansed. Weber has recommended the employment of elastic bougies as a means of dilatation of the duct. These have a diameter of one and a half millimètres at their extremity, but increase to a diameter of four millimètres, and on being introduced forcibly dilate the passage. Laminaria bougies have also been employed, which being introduced in the dry state absorb water, swell, and thus forcibly dilate a stricture. The objection is that they are brittle, and have been known to break off at the point where they were compressed by the stricture, the lower fragment blocking up the canal below this point, and being then exceedingly difficult to remove.

The Method of Weber.—In this method of treatment, reliance is placed on the action of a conical sound to break down or forcibly dilate the stricture. Weber employs a very small probe-pointed knife, with a cutting edge of about one-third of an inch in length and a breadth of blade of one-twelfth of an inch. The lower lid being drawn outwards, and thus put on the stretch, the small button at the end of the knife is introduced into the punctum, and the canaliculus slit up for the greater part or the whole of its length; the conical sound is now gently pressed down the lacrymal sac and nasal duct.

The Method of Stilling.—This is founded on the supposition that the obstruction to the flow of tears is due to the presence of valve-like folds and rugæ in the sac and nasal duct, the free division of which leads to the formation of cicatrices. The contraction of the cicatrices obliterates the folds, and the patency of the passage is restored. Stilling first slits up the canaliculus with a probe-pointed Weber's knife, and then introduces, through the wound thus made into the sac, a peculiarly shaped knife, which has a triangular blade about half an inch in length and with a width of one-eighth of an inch. It is strong and substantial, with a thick back, sharp cutting edge, and blunt point. This is made to pass down the nasal duct, and is then partially withdrawn so as to incise the mucous membrane. The blade is then turned about a quarter round, again pressed down and withdrawn, and, by a repetition of this manœuvre, a series of vertical incisions is made in the mucous membrane of the lacrymal sac and nasal duct. This method is sometimes termed stricturotomy, or better, stenositomy. The method may, of course, be combined with the injection of medicated solutions and with the employment of probes.

A different mode of performing stenositomy is, after previous slitting up of the canaliculus, to introduce a knife with a concealed blade or lacrymotome down the nasal duct; pressure on a spring causes the blade to protrude, and the section can be made in any desired direction.

When, after slitting up the canaliculus, dead bone can be felt on the introduction of a probe, the sac should be washed out with some disinfecting solution, as a 3 per cent. solution of resorcin, and then a fluid injected, consisting of equal parts of glycerine and iodoform, with a little water, two or three times daily. The dead bone sometimes slowly disintegrates, whilst, at others, a fragment may become detached, and if felt to be loose may be cut down upon and removed.

In a paper read before the Chicago Society of Ophthalmology, Dr. Hotz recommends that the treatment of lesions of the lacrymal sac should be effected by means of medicated gelatine bougies, having the thickness of Bowman's probes numbered from 2 to 6. The materials with which the gelatine is impregnated are iodoform or carbolic acid (*Journ. of the Amer. Med. Assoc.*, January 26, 1884). Such means would probably be serviceable where there was only disease of the mucous membrane; but in a considerable number of cases, especially when the patient has suffered from lacrymal abscess which has been allowed to maturate and burst spontaneously, the lacrymal bone, or ascending process of the superior maxillary bone, is necrosed, and in such cases the free slitting up of the canaliculus seems to be the only means of cure.

Dr. Gorecki has quite recently recommended and practised an operation to which he has applied the term dacryocautery. In the performance of this operation, he first slits up the superior or inferior canaliculus, then introduces into the nose, through the nostril, a canula, made of silver or platinum, resembling a tracheotomy canula, which is connected with the positive or carbon pole of a battery. A Bowman's probe is then passed down the canaliculus, lacrymal sac, and nasal duct, and a pair of spring forceps in connection with the negative or zinc pole is attached to it. A galvanometer is introduced into the circuit in order that the completion of the current may be recognised. The current, which proceeds from a Grenet's battery, having an electro-motive force of 2,028 volts, is then passed; a luminous shock is felt, followed by tickling in the nose and the formation of a few bubbles of gas. A small mass of inspissated mucus forms round the sound at the inner angle of the eye, but scarcely any pain is felt. In a very short time the sound can be felt to be less tightly grasped, and a larger probe can be immediately passed.

ACUTE INFLAMMATION OF THE LACRYMAL SAC, DACRYO-CYSTITIS PHLEGMONOSA.—In a large proportion of cases this disease is preceded either by epiphora or by mucocele, but occasionally, as in some forms of eruptive fever, it occurs when the lacrymal passages have previously been healthy. It commences with a sensation of heat at the inner angle of the eye and dryness of the corresponding nostril. A swelling soon appears in the region of the lacrymal sac, which is exceedingly tender to the touch: red and hard at first, it quickly presents the characters of an abscess, and in the course of three or four days matures. At this time the swelling and redness may extend over the cheek and nose. The conjunctiva is inflamed, the lids become puffy and œdematous, there is severe throbbing pain, and, if seen for the first time at this period, the affection is often mistaken for erysipelas. In old and weakly patients, and especially in women during lactation, there may be considerable constitutional disturbance; rigors, foul tongue, nausea, frequent pulse, and sleeplessness being common symptoms. The matter now approaches the surface, the skin becomes purple at the most prominent part, and if left to itself at length gives way at one or more points, allowing the discharge of thick pus, sometimes mingled with membranous shreds of dead tissue. The symptoms now recede, the area of redness diminishes, the pain subsides, the lids resume their normal volume, and vision, prevented by their swelling, again becomes possible.

A *lacrymal fistula* may remain, opening either on the cheek or in the sac of the conjunctiva, though in general the wound heals and a scar alone remains to show where the abscess broke. In most cases that have been allowed to run their course unchecked, some part of the bony parietes of the lacrymal sac becomes necrosed, and in some instances still more serious results have been observed, such for example as orbital abscess, and even meningitis. The treatment is identical with that of an abscess in any other region. In the first instance, hot bread and water or linseed-meal poultices should be applied, and an emetic of thirty grains of ipecacuanha, with or without a grain or two of potassio-tartrate of antimony. Active emesis, with the administration of full doses of quinine, will often arrest the progress of the disease, and will in all instances facilitate the subsequent treatment. If pus be evidently present, and fluctuation can be perceived, a free opening should be made into the sac, and this may either be accomplished by entering the point of a Graefe's linear knife opposite the inner canthus of the eye and cutting in a curved direction downwards and outwards, or a grooved probe may be introduced into the canaliculus, and the sac opened by slitting up this passage. A Weber's probe may then be passed down the nasal duct, and the original cause of the disease may thus in some instances be removed. Finally, an injection of solution of carbolic acid containing 1 to 2 per cent. of the acid may be injected, and a tent, wetted with the same fluid, may be inserted.

INJURIES OF THE LACRYMAL SAC AND NASAL DUCT are occasionally met with as the result of direct violence. In such cases the bones adjoining the canal are often fractured, and in the first instance hæmorrhage and emphysema, and subsequently epiphora, are observed. The emphysema may cause considerable swelling of the lids, and is recognisable by its doughy feeling and its crepitation. The occlusion of the lacrymo-nasal canal, which results from fracture and leads to epiphora, is difficult to treat. The course of the canal is altered, its diameter is diminished by projecting portions of bone, and callus may be thrown out to an extent which completely obliterates the passage. The introduction of a probe then becomes extremely difficult or impossible, and if undue force be used, sharp hæmorrhage may occur from laceration of the mucous membrane, and the bone may even be penetrated. HENRY POWER.

LACTATION, Disorders of. *See* BREAST, Diseases of the.

LAPARO-ELYTROTOMY.—This is an operation proposed as a substitute for Cæsarean section, and for the delivery of the child when this is impossible by the natural passages, either from contraction or deformity of the pelvic bones, from obstruction due to some pelvic tumour, or to disease of the cervix uteri.

In 1806, Jörg suggested cutting through the abdominal wall by an incision extending from the spine of the pubes to the anterior spine of the ilium, then cutting through the vagina, and delivering through the os uteri. In 1820, Ritgen proposed the same operation, but whereas Jörg proposed to cut through the peritoneum, Ritgen advised lifting it out of the way. Ritgen is said to have performed the operation with a fatal result. In 1822, Physick of Philadelphia again proposed the operation, and in 1823, A. Baudelocque, jun., attempted to perform it, but abandoned it and performed the Cæsarean section.

In 1870, Dr. Gaillard Thomas, of New York, performed the operation upon the dead subject several times, and believed that the idea had originated with himself, until his attention was called to the literature of the subject. In the same year he performed the operation, and delivered a living child, but both mother and child died in a few hours. Dr. A. J. C. Skene, of Brooklyn, then operated three times; in the first case the child's head had been already perforated, and the mother died in seven hours; in the second case both mother and child survived, but the former had a small vesico-vaginal fistula as the result of the operation; this was afterwards closed by operation, and she was well in 1876; in the third case both mother and child survived, but again there was a vesico-vaginal fistula, which healed spontaneously. Eight years later Dr. Thomas operated successfully; but again the bladder was injured, and a fistula resulted, which healed without operation.

Operation.— Dr. Thomas advises the operator to be provided with a pocket case of instruments, an anæsthetic, Barnes's dilators, and Paquelin's cautery, or the ordinary cautery-irons.

The patient is laid upon her back upon a firm table, and the os is fully dilated with Barnes's dilators. The abdominal parietes are incised on the right side, from the spine of the pubes, along the upper edge of Poupart's ligament, to the anterior superior spine of the ilium. When the peritoneum is reached it is lifted out of the way. The operator or an assistant passes his finger from the vagina through the dilated os, and pushes up the vagina, which is incised from above at its junction with the uterus. The opening in the vagina is then enlarged by tearing it downwards, and the child delivered through the abdominal wound; by version, if the head or arm present, by extraction, if the breech do so. The placenta is then delivered, and the uterus made to contract firmly. The wound is cleansed by a stream of carbolised water poured through it, and escaping by the vagina. Hæmorrhage is checked by ligatures, by the cautery, or by tampon. The abdominal wound may be left open or closed by sutures, a track being left for drainage. Antiseptic syringing of the wound and vagina is employed afterwards, if necessary. The application of Listerism to the whole procedure, with a light antiseptic packing of the vagina during the early days after the operation, would certainly decrease the risk.

The advantages claimed for the operation are that it avoids opening the peritoneum and incising the uterus, and is easy and rapid; but it does not seem, so far, to have made much way with obstetricians, and has been rarely performed.

J. Knowsley Thornton.

LAPAROTOMY FOR INTESTINAL OBSTRUCTION.—This operation consists, essentially, in making an opening into the cavity of the abdomen. In cases of intestinal obstruction it has been performed as an exploratory operation; it has been used as a means of treatment in strangulation by bands, &c., and through slits and apertures; in strangulation by the true diverticulum or an adherent appendix, &c., in all forms of internal hernia, in reduction *en masse* after external hernia, in all forms of volvulus and of intussusception. By its means, obstruction due to impacted foreign bodies has been relieved, and also that due to compression of the bowel by tumours &c. situate without the intestine. It is made a preliminary to such other operations as enterotomy and resection of the intestine.

The operation of laparotomy should always be performed with antiseptic precautions. The incision should be made in the middle line between the umbilicus and the pubes, and should be large enough to allow the whole hand to be at once introduced into the abdomen. The median incision is better than an incision made over the supposed seat of the obstruction. The former incision is simple, involves no large planes of connective tissue, cuts through no vessels of any magnitude, disturbs no muscular tissue, and is readily adjusted. Through it, the whole abdomen can be explored and the intestine well examined. It can be made, moreover, independently of a very precise diagnosis. The bladder should be emptied before the incision is made, and, in cases where firm pelvic adhesions exist, it is well to make out its position with a sound. When the abdomen is opened, the intestines must on no account be allowed to protrude. They must be retained by flat sponges wrung out of warm carbolised water. If the distension of the bowels is so extreme that there is difficulty even in introducing the hand, the distended loops may be punctured in many places with a capillary trocar. When the hand has been introduced, the first part to be sought for in an obscure case is the cæcum. If the cæcum is flaccid and empty, then the obstruction must be in the small; if it is greatly distended, then it will be in the large intestine. In the latter instance, the fingers must be carefully passed along the whole length of the colon, from the cæcum to the rectum, in search of the obstruction. In the former instance, the fingers should be passed into the pelvis to make search for flaccid loops of small intestine which are *below* the obstruction. If such be found, they must be followed up until the obstruction is reached. In any obscure case every hernial orifice should be examined from within.

If a slender band is found, it may be torn through with the finger. Larger bands and most omental cords should be secured with a double ligature, and then divided between the two threads. A narrow pipe-like diverticulum may be treated in the same way. Large diverticula, especially when disposed to gangrene, should be excised near their point of origin from the bowel, and the wound closed by many points of Lembert's suture. In cases where the appendix vermiformis has to be divided, its cut end may be secured by a single ligature or by several points of suture. If an intussusception be found, it should be, when possible, reduced. This is effected partly by traction and partly by squeezing the lower end of the invaginated mass, so as to press the intussusception out of the sheath.

After the operation, the peritoneal cavity should be carefully sponged out and the wound in the parietes united in the same manner as the wound after ovariotomy. In laparotomy for intestinal obstruction exclusive of intussusception, the mortality, as estimated from 122 recorded cases, is 63·1 per cent. The fatal result would appear to depend, not so much upon the cause or site of the obstruction or the age of the patient, as upon the time at which the operation is performed and the state of the bowel when relief is attempted. The most serious factors in the procedure are delay, and the evil practice of regarding laparotomy as a last resource. In many cases it should be the first, since it is really the only resource. The mortality of laparotomy performed for intussusception is 72·7 per cent., as estimated from 33 recorded cases. Here, the fatal issue depends very conspicuously upon the time at which the operation is performed and the state in which the invagination is found. Thus, the mortality, in cases where the reduction of the intussusception had been easy, was 30 per cent., while the mortality, in cases where the reduction had been difficult or impossible, was no less than 91·3 per cent.

Frederick Treves.

LARDACEOUS DISEASE. *See* Albuminoid Degeneration.

LARYNGEAL CARTILAGES, Fractures of the, are produced by direct violence, such as an attempt to strangulate, a blow, or a fall against some projecting object. The thyroid cartilage is most frequently broken, and usually in the median line. Adults are more liable to the injury, on account of the rigidity of their cartilages. Repair may follow either by bone or by fibrous tissue, but the injury is often fatal, especially when the cricoid has been fractured.

The *symptoms* are pain in the seat of injury, swelling, ecchymosis, and some alteration of the natural shape of the parts. The voice is husky, or altogether lost. There may be coughing, hæmoptysis, and dyspnœa. The patient is sometimes unable to swallow. Upon manipulation, abnormal projections or depressions may be felt, with mobility of parts of the cartilages, and crepitus may sometimes be detected. The surgeon, however, should remember that a crackling sensation may be conveyed to the fingers when the healthy larynx is rubbed against the vertebræ. In some cases, the dyspnœa does not occur until the submucous tissues have become inflamed.

Treatment.—The patient should be kept lying down, and he should not be allowed to speak. Liquid food should be given, and, if swallowing is painful or disturbs the fragments, it may be necessary to use the œsophageal tube or nutrient enemata. An attempt should be made, if there is any displacement of the fragments, to reduce them, and to maintain them in position by pads of lint and strapping. An ice-bag may be applied to check hæmorrhage and diminish inflammation. When there is dyspnœa, and especially if this should be accompanied by hæmoptysis, laryngotomy or tracheotomy should be immediately performed. After the air-passages have been opened, and before the tube is tied in, the opportunity should be taken to explore with a probe the condition of the parts above, and as far as possible to restore them to their normal relations. In many cases, laryngotomy would be the preferable operation, as, if there was any difficulty in retaining the cartilages in their proper position, it would be easy to extend the incision upwards, and, after exposing the fragments, to fix them in their place by a few sutures.

N. Davies-Colley.

LARYNGITIS, including *acute laryngeal catarrh, acute laryngitis, hæmorrhagic laryngitis, œdematous laryngitis, traumatic laryngitis, abscess of the larynx.*

Causes.—Acute inflammatory affections of the larynx may be produced by the influence of the weather, especially in persons of sedentary habits and indoor occupations; excessive use of the vocal organs; extension of a similar affection from neighbouring parts, notably from the pharynx; inhalation of hot and irritating vapours; entrance of foreign bodies into the larynx; scalds, corrosive poisons. They often accompany the acute exanthemata, especially measles. Acute œdematous laryngitis may either represent a most violent type of acute catarrhal inflammation of the larynx (though this is extremely rare) or be due to blood-poisoning (erysipelas); or be propagated from neighbouring parts, especially from the pharynx; or occur in the course of syphilitic and tubercular inflammations, carcinoma, perichondritis and diseases of the cartilages of the larynx; of renal affections, typhoid fever, smallpox, &c.

Pathology.—In slight cases, there is merely injection of the vessels, increased succulence of the epithelial layer, and some swelling of the mucous membrane. With the intensity of the inflammatory process the exudation increases, and in the œdematous form sometimes assumes extraordinary proportions. In laryngitis resulting from corrosive poisons even gangrene may supervene. Abscess of the larynx consists in a circumscribed collection of pus in the submucous tissue of the part.

Symptoms and Diagnosis.—The subjective symptoms of acute laryngitis, in adults, vary from slight soreness in the throat, with hoarseness or aphonia, cough and expectoration (which is at first simply mucous, and only towards the end of the attack becoming somewhat purulent), to severe and even fatal dyspnœa, accompanied by stridulous respiration and cyanosis, in cases of œdematous and traumatic laryngitis, and of abscess of the larynx. In hæmorrhagic laryngitis there is sometimes sanguinolent expectoration. In children, even in comparatively slight cases, the dyspnœa is often very marked, especially at night, and the prominent respiratory difficulty, in these cases, often leads to the disease being confounded with spasm of the larynx or with laryngeal diphtheria. Whether this form of dyspnœa be due to spasm of the adductors of the vocal cords from inflammatory irritation or to collection of inspissated mucus in the narrow rima glottidis of the child, is somewhat uncertain.

The objective symptoms—i.e. the laryngoscopic signs—of acute laryngitis are the following: There is general hyperæmia of the mucous membrane; the vocal cords are more or less congested, and more or less covered by the swollen ventricular bands. Sometimes, the mobility of the cords on attempted phonation is deficient, this being due either to the swelling of the soft parts, or to slight inflammatory changes within the laryngeal nerves and muscles. In hæmorrhagic laryngitis, the bleeding spot may sometimes be detected. In œdematous laryngitis, either the whole organ or a part of it may be affected. The looser the tissue, the more readily is it infiltrated; hence, acute œdema of the larynx affects most often the lax arytæno-epiglottidean folds; after these the submucosa of the epiglottis, the mucous membrane of the arytænoid cartilages and the arytænoid fold, and, least frequently of all, the vocal cords. The appearance of the œdematous parts is most characteristic. Their colour is either of a bright or of a pale transparent red—sometimes grey; the epiglottis is changed into a round, sausage-like body, the two halves of which sometimes appear to be squeezed the one against the other; the arytæno-epiglottidean folds and ventricular bands sometimes attain such enormous dimensions as to meet in the middle line, and, with the swollen epiglottis, prevent inspection of the lower parts. Similar changes obtain in those rare cases in which the vocal cords are affected. The changes in laryngitis from scalds and from impaction of foreign bodies are very similar to those of simple œdematous laryngitis. In abscess of the larynx it will sometimes be possible, when it points, to see the yellow colour of the pus shining through the swelling, and the want of symmetry in the swollen parts may, even earlier, be of assistance in forming a correct diagnosis, but generally it will be difficult to diagnose this form with certainty.

In simple cases of laryngeal catarrh, in adults, the subjective symptoms will generally suffice to enable the practitioner to arrive at a correct diagnosis without the aid of the laryngoscope, though its use is of course always to be recommended. Matters are entirely different in the more serious, especially in the œdematous, forms. All the symptoms present in such cases (violent dyspnœa, aphonia, dysphagia, pain, &c.) are neither sufficient to make the diagnosis conclusive nor to indicate the proper moment for surgical interference. All or most of these symptoms might be produced by the impaction of a foreign body in the larynx, by a retropharyngeal abscess, by laryngeal diphtheria—in fact, by anything leading to narrowing of the upper air-passages; whilst in other cases, in which the acute œdema is secondary to another laryngeal disease (syphilis, tuberculosis, perichondritis, carcinoma, &c.), it will be of the greatest importance to make out the nature of the primary affection. In most cases, therefore, of this sort, laryngoscopic examination will be indispensable in order to arrive at a precise diagnosis. In children, even in simple laryngeal catarrh, there will be occasionally considerable difficulty in differentiating this affection from spasm of the glottis (laryngismus stridulus) and from laryngeal diphtheria. The most satisfactory solution of the problem will also, in these cases, be afforded by laryngoscopic examination. If this, however, be impossible, it ought to be remembered that in catarrhal laryngitis there is often slight fever, with impairment of the voice and cough, even during the intervals of the spasmodic attacks; that in laryngismus stridulus the intervals between the attacks are quite free, that there is no fever, and that there are sometimes carpo-pedal contractions; that in laryngeal diphtheria there is often a corresponding affection in the pharynx, and that occasionally fragments of false membrane are coughed out.

The differential diagnosis between laryngitis and laryngeal diphtheria in children, however, is sometimes excessively difficult during the earlier stages, the graver disease often beginning with simple catarrhal symptoms. It will, therefore, be advisable in such cases to wait a while before giving a positive diagnosis.

Treatment.—Simple laryngeal catarrh tends to resolution, and it is only necessary to enjoin *complete rest* of the inflamed organ. This is of greater importance than any medical treatment. Cold water applications to the neck and sucking small pieces of ice will often, if used at the very onset of the affection, check its further progress. At a later period warm steam inhalations, to which some compound tincture of benzoin, lupulin, or coniin, may advantageously be added, are sometimes useful. If the catarrh affect the nose, pharynx, larynx, and bronchial tubes simultaneously, general diaphoresis often shortens its duration. No local applications of any kind ought to be made during the acute stages. They only come into play when the catarrh, instead of tending to resolution, passes into a subacute or chronic state. See *Chronic Laryngitis.* Gargles and lozenges are of exceedingly little use in laryngeal affections. Children suffering from acute laryngeal catarrh ought to be kept indoors, and in an atmosphere rendered moist by means of a bronchitis kettle. If there be much cough, the mistura scillæ composita of the Throat Hospital Pharmacopœia [Oxymel scill. ♏xv., vin. ipecac. ♏v., tinct. camph. comp. ♏xx., aq. ad f℥j., one or two teaspoonfuls for a dose] will prove a good remedy. In hæmorrhagic laryngitis, the direct application to the bleeding spot—if this can be laryngoscopically detected—of a solution of tannic acid or perchloride of iron will often at once arrest the hæmorrhage. If the exact source of the bleeding cannot be detected, inhalations of a cold perchloride of iron spray (gr. iij.–x. ad aq. f℥j.), cold water compresses round the neck, sucking pieces of ice, and absolute rest of body and larynx are recommended.

In all forms of acute œdematous laryngitis very active treatment is required. The diagnosis having been established by laryngoscopic inspection, but little time should be lost with internal remedies and external applications. If the administration of an emetic, ice internally and externally, leeches to or blisters and mustard poultices around the neck, fail to give relief within a short time; and if, on the contrary, the symptoms of stenosis and carbonic acid poisoning increase, an energetic scarification of the œdematous parts, especially of the arytæno-epiglottidean folds, ought to be made by means of Mackenzie's laryngeal lancet, or of a long sharp-pointed bistoury enveloped, except at its point, in adhesive plaster. The writer has in several cases seen the progress of acute œdema of the larynx checked and the necessity for tracheotomy avoided by this operation, which is not difficult of execution. Should the practitioner, however, be unable to perform it, or should it not soon be followed by considerable abatement of the symptoms, tracheotomy ought to be undertaken without delay, and if promptly performed it will save the patient's life. (As to the after-treatment of that operation, *see* TRACHEOTOMY.)

Abscess of the larynx ought to be opened as soon as possible from within, under the guidance of the mirror, by means of the laryngeal lancet. If it be very large and there be the danger of the patient being suffocated by the escape of pus into the lower air-passages, it might be necessary to perform tracheotomy as a prophylactic measure, and to insert a tampon-canula into the trachea before the abscess is opened from above.

CHRONIC LARYNGITIS.—*Causes.*—Many of the causes leading to acute inflammatory affections of the vocal organ produce, when continually acting, or when the acute stage is neglected and no rest be given to the inflamed part, chronic laryngitis. The most frequent causes are, exposure to influences of temperature, persistent use of the voice when the larynx is acutely inflamed, excessive use of stimulants, extension of a similar affection from the pharynx.

Pathology.—Tumefaction of the affected parts, due to hyperplasia or dermoid metamorphosis of the mucous and submucous tissue, increase of the connective tissue, enlargement and tortuosity of the small vessels, in much developed cases occasionally denudation of epithelium, very rarely amounting to superficial ulceration. A particular form, in which swelling of the mucous follicles is said to be the prominent feature, has been described as granular, glandular, or follicular laryngitis. In another rare class of cases, hypertrophic indurative changes are most pronounced in the subglottic region.

Symptoms and Diagnosis.—The symptoms are hoarseness, rarely amounting to complete aphonia and varying in intensity, early fatigue of the voice ; sometimes cough with a little tenacious expectoration, sometimes absence of all subjective sensations, sometimes sensations of dryness, heat, pricking, soreness, &c. In the subglottic form aphonia is often complete, and there is, corresponding to the amount of hypertrophy and to the degree of the narrowing of the glottis, more or less urgent dyspnœa. The laryngoscope shows either a general or a more partial thickening and congestion of the mucous membrane. The colour of the congested parts, however, is not so bright and uniform as in acute laryngitis, but darker and more irregular. Sometimes the ventricular bands are so much swollen as to entirely conceal the vocal cords; sometimes the latter appear irregularly thickened, showing ecchymotic patches or swellings. In other cases, the mucous membrane in the inter-arytænoid space is thickened, and, being squeezed on attempted phonation between the inner surfaces of the arytænoid cartilages, mechanically prevents the complete juxtaposition of the vocal cords.

In subglottic laryngitis, the tumefaction sometimes appears in the form of a second whitish, greyish, or reddish vocal cord underneath the true vocal cord ; sometimes, an almost complete sphincter-like projection below the cords is perceived ; sometimes, several projections underneath different parts of the cords or under the anterior commissure are seen.

For a correct diagnosis, laryngoscopic examination is indispensable for almost all chronic laryngeal affections : neoplasms, perichondritis, syphilis, phthisis, nervous disorders, &c., being accompanied by symptoms closely resembling those of chronic laryngitis. On the other hand, the laryngoscopic appearances described above are quite characteristic of chronic laryngitis, and the only point not to be lost sight of is that chronic laryngitis does not necessarily occur as an independent disease, but also in the course of other affections (typhoid fever, acute exanthemata, syphilis, &c.).

Treatment.—It is the writer's firm conviction that neither gargles, nor lozenges, nor inhalations, nor internal treatment, nor visits to watering-places, &c., alone will ever cure chronic laryngitis. There being actual changes in the histological conformation of the parts, the only rational treatment consists in changing the torpid inflammation into a reactive one by the local application of strong astringent remedies, and to watch the course of this until its natural termination in resolution has been achieved. With this view, in more recent cases applications of a solution of chloride of zinc (15-30 grains to the ounce) ought, under the guidance of the mirror, to be made to the larynx by means of a suitably curved camel-hair brush, or of a small sponge safely attached to a properly bent probe. Instead of the zinc, perchloride of iron, alum, or tannin solutions may be used. The best remedy, however, in these cases, especially in long-standing ones, is nitrate of silver, which may be employed in solutions of 16, 24, 48 grains to the ounce. In very severe cases still stronger solutions (96 grains to the ounce), or even the solid stick, may be required. It is, however advisable, in every case, to begin with the milder solutions, and only gradually to pass on to the strength which is deemed necessary in the individual case. The initial irritability becomes soon diminished, and stronger solutions may then be safely applied. To prevent spasm of the glottis following the introduction of the brush, the patient is to be advised, before the application is made, to stop breathing for a second or two altogether, and then to begin again to breathe quite superficially through his nose. His attention being thus diverted, the spasm is almost always avoided. Drinking a little cold water relieves in all instances the spasm, if it should occur. The application should be made daily, if necessary in increasing strength, until a lively reactive inflammation is produced. The intervals are gradually to be made longer, and weaker solutions must be applied, according to the individual case. If there be a corresponding pharyngeal affection (granular pharyngitis), it is essential that this should be simultaneously treated. The treatment leads as a rule to speedy improvement even in old-standing cases, but ought to be continued until the last trace of the thickening and congestion of the parts has disappeared, there being a great tendency to recurrence unless the affection has been entirely stamped out. Sometimes, the improvement proceeds to a certain point and then becomes arrested. In such cases, it is well to combine the astringent applications with the use of electricity in both its forms —the constant and the faradic—to the sides of the larynx. If, on the other hand, the hyperplastic process should already have resulted in the formation of a well-defined neoplasm, astringent treatment is perfectly useless ; the attempt to treat the growth by caustics is even injurious to the neighbouring parts, and the case belongs to the sphere of surgical interference. *See* Larynx, Growths in the.

During the whole of the often lengthy treatment, rest of the voice, discontinuance of excess in spirits, tobacco, &c., must be strongly insisted upon; disobedience in these respects leading almost invariably to its failure. It is, however, neither advisable nor necessary to altogether interdict moderate smoking and use of alcohol. Only in cases of general plethora is the regular use of some aperient (Friedrichshall water) indicated; otherwise no constitutional treatment is required. Inhalations may be looked upon as merely an aid to the rest of the treatment; the writer has little faith in them in these cases. If ordered at all, soothing steam inhalations, with the addition of some compound tincture of benzoin, lupulin, coniin, or oleum pini sylvestris are to be used. The patient is to wash his neck and chest in the morning with cold water, to wear flannel underclothing, but not to wrap up the neck. A good aid towards a lasting cure is a visit to a suitable watering-place (Ems, Reichenhall, Ischl, Royat, Mont Dore, &c.) after the conclusion of the local treatment.

In the subglottic form of disease, the treatment is more difficult than in common chronic laryngitis, and the prognosis much more unfavourable. Unless the measures recommended in the common form—which must in these cases be pushed still more assiduously—be successful, methodical dilatation by means of Schrötter's hollow vulcanite tubes, scarification, or galvano-caustic reduction of the hypertrophic parts will have to be resorted to; if, in spite of all these measures, the dyspnœa increases to an alarming degree, tracheotomy must be performed, after which operation the attempts at dilating the strictured portion may be resumed either from above or from the tracheal opening.

Felix Semon.

LARYNGOSCOPY.—To examine the interior of the larynx, a small mirror attached to a long handle must be introduced into the patient's throat. The reflecting surface of the mirror is to be directed obliquely downward, and a powerful light is to be thrown upon it, when the light will be reflected into the larynx and the laryngeal image will be visible on the mirror.

The light used may be either natural (sunlight, diffused daylight), or artificial (electric, lime, gas, lamp, candle-light). The stronger it is the better, especially for the examination of the more minute pathological changes and of the lower parts of the air-passages (sub-glottic cavity, trachea). The examiner should, however, acquire facility in examining with diffused daylight, which is preferable to the poor artificial illumination often offered to him in the private residences of patients. For use in the consulting-room, Mackenzie's rack-movement lamp, in which a plano-convex lens is placed in front of the flame, thus increasing the intensity of the light, is to be recommended.

The rays of light are thrown into the throat by means of a circular, slightly concave mirror, the so-called 'reflector,' about 3½ inches in diameter and of a focal length of 14 inches. This is attached by means of a ball-and-socket joint either to a spectacle frame, or to a frontal band which the operator affixes to his forehead. The spectacle frame possesses the additional advantage that myopic or hypermetropic practitioners can have their glasses fastened to it. The reflector should be perforated in its centre by a small oval opening, and, when in position, the long diameter of the perforation should correspond to the long axis of the observer's eye. The small mirror, attached at an angle of about 120° to a long shank and handle, is made in several sizes, of which the practitioner should have at least three (½, 1, 1½ inches in diameter); the largest size possible should always be used. Strict attention to the following mode of procedure is advised. The patient is to sit on a common chair opposite the observer, the lamp used for illumination being placed at the patient's left side on a table (or held by an assistant) near to the patient's left ear. For a satisfactory illumination it is essential that the centre of the source of light, the centre of the patient's mouth when opened, and the centre of the reflector should be as nearly as possible on one and the same level. Neglect of this fundamental rule is one of the most fertile sources of failure among beginners.

The patient is now told to open his mouth, and the practitioner throws a disc of light from the reflector into the throat, so that the centre of the disc falls upon the uvula. The patient is then directed to put out his tongue, and the anterior part of the organ is enveloped in a small soft towel, and held between the thumb (above) and the forefinger (below) of the practitioner's left hand, the forefinger and other fingers resting on the patient's chin. The mirror is warmed over the lamp previous to its introduction, to prevent the expired air condensing on it. The proper temperature is obtained as soon as the film, which at first forms on its reflecting surface, is seen to disappear. To obviate, however, applying the mirror when too hot, the practitioner should never introduce it without having tested its temperature by applying it to the back of his hand. The patient is now instructed to breathe quite naturally, and the mirror—its handle being held like a pen—is introduced in the mesial line of the patient's mouth, and quickly moved forward until its upper border touches the base of the uvula. During the act of introduction the mirror is to be held horizontally, the reflecting surface looking downwards, and the shank of the instrument being close to the left angle of the patient's mouth. Touching the tongue or the faucial pillars should be carefully avoided. As soon as the mirror is beneath the uvula, it ought to be turned upwards until its reflecting surface forms an angle of 90° with the horizon. In this position it is gently but firmly raised, until its upper border is at the same height as the base of the uvula, that organ resting on the posterior surface of the mirror. According to the optical law that, when rays of light fall on a plane surface, the angle of reflection is equal to the angle of incidence, the horizontal rays of light falling from the frontal reflector at an angle of 90° are reflected in an equal angle—i.e. vertically downwards; the larynx, which is just beneath the mirror, is illuminated, and its image, in turn, appears in the mirror, where it is seen by the observer. The use of the writer's electric laryngoscope (see *Lancet*, March 1885), in which the source of light, a small incandescent lamp, is close to the little mirror, and is actually introduced into the patient's throat, does away with the difficulty of double reflection.

It ought to be noted that the only inversion which takes place, under these circumstances, is one in the antero-posterior direction; the parts in reality in front of the larynx (e.g. the epiglottis, the anterior commissure of the vocal cords, &c.) appear in the upper part of the mirror, whilst its posterior constituents (e.g. the arytænoid cartilages) are visible in the lower part of the mirror. But there is no lateral inversion—that is to say, the vocal cord which appears in the left side of the mirror (reckoned from the *observer*)—i.e. on the *patient's right* side—is in reality the patient's *right* vocal cord, and *vice versâ*. In cases in which the whole larynx comes into view, the image thus obtained comprises, in the upper part of the mirror, the epiglottis, of which generally the free border and the upper surface are seen, further down the vocal cords (their white colour vividly contrasting with the other parts of the larynx), between them the subglottic cavity, and a part, varying in length, of the anterior wall of the trachea. At the sides of the vocal cords, the ventricular bands (false vocal cords) are seen; between the vocal cords and ventricular bands a small rim, the opening of the ventricle of Morgagni. The ventricular bands are continuous externally with two projecting folds of mucous membrane, the arytæno-epiglottidean folds, and outside these a cavity becomes visible between them and the lateral wall of the pharynx. This is the hyoid fossa or the sinus pyriformis, a part surgically important, because it is one of the seats of predilection for the lodgment of foreign bodies finding their way into the air-passages. Posteriorly, —i.e. in the lower part of the mirror—the arytæno-epiglottidean folds end in the arytænoid cartilages, and often the cartilages of Wrisberg and Santorini can be recognised in the outline of these folds.

The laryngeal image seen in the mirror is, however, by no means always so complete as that just described. It will be often necessary to move the mirror slightly, or to let the patient draw his head further back, or to let him produce the sounds, *ah*, *eh*, *e*, in order to obtain a satisfactory view. The following faults should be avoided: undue haste, attempts at examination without having concentrated the light properly, violent pulling of the patient's tongue, clumsy introduction of the mirror (at times insufficiently warmed, at others overheated), inducing irritation of the tongue and fauces, omitting to tell the patient that he must breathe quietly, holding the mirror too long in the patient's throat, neglect of the little manœuvres sometimes necessary to make a pendent epiglottis rise. This list does not exhaust all the causes of failure due to the fault of the operator, but only includes those which, in the experience of the writer, occur most frequently and are especially to be avoided. On the side of the patient the most common difficulties are: nervousness, over-sensibility of the pharynx, unruliness of the tongue, enlarged tonsils, an elongated uvula, and—most serious of all—a pendent epiglottis. All these difficulties can, however, be overcome by tact, gentleness, perseverance, the application of suitable instruments, and above all by continuous practice. In cases of exceptional irritability, and especially when intra-laryngeal operations are to be performed in nervous persons, the patient may suck little pieces of ice from fifteen to twenty minutes before the examination takes place. Recently, the local application of hydrochlorate of cocaine (in 10 or 20 per cent. solution) by means of a brush to the palate and pharynx has been found to be an excellent aid, in cases of hyperæsthesia of these parts. Local anæsthesia comes on a few minutes after the application, and lasts ten to fifteen minutes.

In conclusion, it is recommended that the signs offered by the inspection of the larynx be taken in the following order: (*a*) colour, (*b*) structural changes, (*c*) functional changes (mobility of the parts). As regards (*a*), it may be remarked that the vaso-motor changes in the larynx are very rapid, so that anæmia present on the first introduction of the mirror may, on its second, have given way to normal coloration, and to hyperæmia on its third introduction. Isolated laryngeal anæmia being a valuable diagnostic sign, it is advisable to make it a rule to devote the first glance into the larynx to the ascertainment of this inconstant factor, whilst the lasting features of the image—i.e. questions appertaining to structural and functional changes—may be safely left to a repetition of the inspection.

As regards (*b*). Under this head we shall have to look for swelling, thickening, abscess, œdema, ulceration, dislocations, malformations, new growths, foreign bodies, &c.

As regards (*c*). No definite conclusion concerning the mobility of the parts—i.e. the functions of the larynx—can, as a rule, be gained unless the larynx has been examined during phonation as well as during respiration. Failure to comply with this fundamental rule will lead to the overlooking of laryngeal paralysis, in many cases.

Felix Semon.

LARYNGOTOMY.—The term is used, in this country at least, to describe the artificial opening of the larynx through the crico-thyroid membrane. The Germans speak of this as 'partial laryngotomy,' to distinguish it from 'complete laryngotomy,' which we call thyrotomy (*see* Thyrotomy). Certain advantages were formerly claimed for this procedure, the chief of these being the facility and rapidity with which the operation could be performed. The limited space, the proximity of the vocal apparatus, the difficulty in fitting a suitable tube, detract, however, from the value of this operation. In children under twelve years of age, owing to the smallness of the larynx, and especially of the crico-thyroid space, it is quite inapplicable; while, in adults, the circumstances which call for it in preference to any other operation are but rarely met with.

Laryngotomy may be indicated when a ready and convenient access to the larynx is required; but there are few occasions when this operation is specially called for. The impaction of a foreign body, some cases of polypus and of localised morbid growths at or about the upper orifice of the cricoid cartilage, cases of laryngeal spasm (as in epilepsy or tetanus), some cases of drowning (to facilitate emptying of the lungs and subsequent artificial respiration), would, among other cases and causes, suggest and justify its adoption.

The Operation.—Unless the dyspnœa is very urgent and the patient partially insensible, an anæsthetic should be given. Ether causes increased bronchial secretion, which in many cases would be a serious drawback; chloroform should therefore be used. In administering it, especially in children, the surgeon should proceed very slowly at first, and allow the patient to sit up or lie down, as most agreeable to himself; a constrained position leads to a greater sense of suffocation, to struggling, and so to venous engorgement of the neck. A feeling of drowsiness quickly supervenes when a few drops of chloroform are slowly inhaled on a handkerchief; the dose may be gradually increased until narcosis is complete. The patient should then be placed in the recumbent position, with the shoulders resting on a cushion and the head thrown back. The thyroid cartilage is felt for with the left index finger; from its lower margin a vertical median incision, about one and a half to two inches long, is made through the skin and fascia, which are then to be retracted with blunt hooks; the crico-thyroid membrane now comes into view in the middle line, covered on each side by the crico-thyroid muscle, and must next be incised. Some surgeons make a horizontal, while others prefer to make a vertical incision through the membrane; this incision may even include the cricoid cartilage, the term 'laryngotomy' being still strictly applicable to the operation. If the vertical incision be adopted, the crico-thyroid artery, which crosses the membrane, is sure to be cut, and may possibly give rise to troublesome hæmorrhage; it should be taken up with forceps and be either twisted or tied. The advantage of this incision is that it can be prolonged either upwards or downwards, should circumstances render such a proceeding desirable. In this manner, a 'partial' laryngotomy can be converted into a 'complete' one, or into a laryngo-tracheotomy; moreover, a vertical incision interferes with the integrity of the larynx less than a transverse one, which almost necessarily includes the crico-thyroid, and possibly the lateral crico-arytænoid muscles. Especially in cases where a tube must be subsequently worn, do the advantages of laryngo-tracheotomy become obvious; for a tube can be worn more comfortably in the trachea than in the larynx.

After-treatment, &c.—The reader may refer to what has been said under this heading in the article on TRACHEOTOMY. It will suffice to state here that the after-treatment, in any given case, is determined by the lesion calling for the operation, rather than by the operation itself. After the removal of foreign bodies, for instance, the wound will probably heal without any trouble within a few days. *Complications* may occur as after tracheotomy. As regards the voice and the vocal apparatus, they are more likely to be interfered with after section of the crico-thyroid membrane than after a simple tracheotomy, by reason of their greater proximity.

ROBERT WILLIAM PARKER.

LARYNGO-TRACHEOTOMY. *See* LARYNGOTOMY.

LARYNX, Extirpation of the (Laryngectomy).—Extirpation of the larynx is sometimes practised in cases of malignant disease. The operation was first carried out on the human subject by Dr. P. H. Watson in 1866, on account of cicatricial narrowing of the larynx. Subsequently, Billroth of Vienna removed the larynx and upper rings of the trachea for carcinoma; the man lived seven months, dying from recurrence of the growth, which commenced about four months after the operation. Bottini operated very successfully for sarcoma of the larynx; the man recovered and resumed work. Foulis successfully operated on a man with a soft papilloma; this patient lived two years. One of Thiersch's cases lived three years and seven months. A few others have lived for two months and upwards. When death has not actually occurred from the effects of the operation itself, recurrence or spread of the disease has always taken place sooner or later. Thus, it may be said that, unless the disease is strictly localised, little is gained by extirpating the larynx; whereas death may occur directly from it. On the whole, tracheotomy is a more hopeful palliative measure than laryngectomy.

The Operation.—The patient being anæsthetised, and in a reclining position, a vertical incision should be made in the median line of the neck from the hyoid bone to the isthmus of the thyroid gland; the soft structures are then to be carefully dissected from the larynx. When exposed, the trachea may be cut across and raised up out of the wound; into its distal extremity a suitable canula is to be introduced and so fixed that, while it prevents the entrance of blood, respiration can go on undisturbed. The larynx is then gradually detached from its connections, beginning *from below*; this greatly facilitates the operation, for, as the hæmorrhage gravitates away from the part actually being operated upon, the surgeon can see what he is about. It is very desirable to take up all the bleeding vessels one by one as they come into sight, and tie them with carbolised or sublimated silk. Care must be taken not to button-hole the œsophagus. In some of the recorded cases, owing to unexpected implication of the pharynx, portions of the latter have had to be removed with the larynx. After the operation is completed, the hole may be plugged with absorbent antiseptic wool or gauze; this must be changed twice, or oftener, daily, and such lotions or other applications used as each individual case seems to call for. Should recovery take place, an artificial larynx may be fitted. Liquid nourishment must alone be given at first; this is best administered through a soft œsophageal tube, provided with a funnel-shaped extremity.

The *prognosis* in all these cases must be very guarded. Apart from the fact that the operation is most frequently undertaken for carcinoma, there are grave risks attending it; should these be got over, there is considerable risk from the onset of septic pneumonia during the subsequent two or three weeks; while, later, the fear of relapse, of recurrence, or of secondary growths, can never be quite banished.

Robert William Parker.

LARYNX, Growths in the.—A. Non-malignant Growths.

Causes.—All the causes leading to chronic inflammation of the mucous membrane of the larynx (see *Chronic Laryngitis* under Laryngitis) appear to favour the development of neoplasms in that part. This explains the fact that the male sex is, according to all experience, more liable to the disease than the female. Sometimes, no doubt, the disease is congenital, in other cases the etiology is quite obscure. Whilst some forms (especially papillomata) are met with in early infancy, and no period of life is exempt from such affections, benign growths in the larynx are probably most commonly met with in middle life—i.e. between the ages of thirty and fifty. Although, even in much more advanced periods of life, benign neoplasms occur, yet, if the history of the patient shows that the disease *commenced* after the fiftieth year of life, the surgeon will do well to remember the probability of the growth being malignant.

Pathology.—The benign neoplasms met with in the larynx are: papillomata, fibromata, cysts, myxomata, angiomata, adenomata, lipomata, and enchondromata. Of these the first two are by far the most commonly met with; cysts, though by no means so rare as believed up to recent date, following at a very long interval, and the remaining forms being excessively rare.

1. Papillomata.—Papillomata of the larynx consist of papillæ occurring singly or in groups. Their colour is white, grey, or pink, their form mostly cauliflower-like or warty. After extirpation they tend to recur. They may be solitary or multiple, pedunculated or sessile, unilateral or bilateral. Sometimes, multiple papillomata fill almost the whole larynx. The favourite seats of the growth are the vocal cords—in the experience of the writer especially their anterior commissure—the ventricular bands, and the ventricles of Morgagni. They often spring from the lower surface of the true cord, but never from the interarytænoid fold.

2. Fibromata.—Laryngeal fibromata consist of bundles of white, closely interwoven fibres, covered generally with squamous epithelium, and supplied more or less richly with blood-vessels. Their consistence is much harder than that of papillomata; their form round, oval, or multilobular, and their surface generally smooth; their colour white, pink, scarlet, or, in rare cases, bluish red; their size varies from that of a pin's head to that of a hazel-nut. They may be either pedunculated or sessile. They are almost always solitary, spring usually from one of the vocal cords, grow very slowly, and sometimes become arrested in growth after having attained a certain size. When extirpated they do not recur.

3. Cysts of the larynx are almost always of the nature of follicular retention cysts. They grow most frequently from the back of the epiglottis, the laryngeal ventricles, and from the free borders of the vocal cords, and are generally filled with either serous or colloid material. Their walls are in most cases thin, so that they can be easily pricked. Occasionally, however, the walls are firm, and offer considerable resistance to cutting instruments. Their appearance is generally that of a greyish, somewhat transparent bladder; their size usually varies from that of a pin's head to that of a small cherry; but the writer has lately seen an epiglottidean cyst — the largest, he believes, ever observed—which was of the size of a bantam's egg. After pricking they either at once collapse or slowly give exit to a tenacious colloid fluid. Sometimes they fill again after having been emptied, and in such cases they not rarely change into blood-cysts.

The remaining forms of benign laryngeal neoplasms occur so rarely, that it must suffice to mention that, in quite exceptional cases, new formations of mucoid, vascular, fatty, glandular, and cartilaginous tissue have been observed.

Symptoms.—The symptoms caused by non-malignant laryngeal tumours depend upon their seat, their size, and their mode of attachment. The vocal cords and their neighbourhood being most frequently the seat of origin of these neoplasms, hoarseness or aphonia is the most frequent symptom. In cases of pedunculated neoplasms, which are swung to and fro by the respiratory current of air, these vocal symptoms are often of a surprisingly varied character, the natural or only slightly altered voice of the patient being present whilst he speaks one sentence, and the next sentence being produced in a toneless whisper, because the neoplasm has in the meantime been thrown upon or between the vocal cords. If a neoplasm situated within the glottis be at all large, or if there be numerous small growths (papillomata) encroaching upon the air-passages, there will, in addition, be more or less considerable dyspnœa, sometimes to a dangerous extent. Again, in cases of pedunculated growth, even if not very large, the neoplasm may, especially during sleep, be suddenly impacted in the rima glottidis and produce a dangerous attack of suffocation. Dysphagia is only present when a growth (cyst) springs from the epiglottis or—in excessively rare cases—extends from the larynx into the œsophagus. Cough is by no means a frequent symptom of laryngeal growths; it is only troublesome in cases of pedunculated tumours, which are thrown about and irritate the mucous membrane after the manner of foreign bodies. Pain is not produced by benign growths.

Diagnosis. — Hoarseness, dysphonia, aphonia, dyspnœa, being concomitants of many chronic affections of the larynx, a certain diagnosis can in most cases only be arrived at by a laryngoscopic examination. Occasionally, a small piece of a papilloma may be coughed out and settle the nature of the ailment; again, the character of the dyspnœa or of the vocal disturbance may vary so much as to lead to a suspicion of its cause, or the patient himself may feel the movements of a pedunculated growth in his throat. But such cases are exceptional, and generally the discovery of a growth will come as a surprise upon both medical attendant and patient.

It is essential, in these cases, that the laryngoscopic examination be not limited to the observation of the larynx during phonation and respiration, but that it be repeated immediately after the patient has been directed to cough, because there are cases of subglottic pedunculated growths, in which the neoplasm can only in this manner be brought into view.

As to the aspect of the different forms of the more common benign neoplasms in the laryngeal mirror, sufficient information has been given in the paragraph dealing with their pathology.

The differential diagnosis between benign and malignant tumours (epitheliomata, sarcomata) of the larynx occasionally offers very serious difficulties. Epithelioma in its early stages—i.e. before the commencement of ulceration—sometimes looks strikingly like papilloma. The presence or absence of a distinct line of demarcation between the neoplasm and the neighbouring tissue; the degree of mobility of the vocal cord, if to this the growth be attached (see *Malignant Growths*, Symptoms); the age of the patient; the presence or absence of spontaneous pain, of tenderness of the larynx on handling, of tumefaction of the neighbouring lymphatic glands, of dysphagia, of hæmorrhages, of cachexia will, in such cases, sometimes give valuable information as to the true character of the neoplasm. Removal of a small fragment of the growth by means of the laryngeal forceps and its microscopic examination will, in most cases, at once settle all doubts. If this measure be impracticable, it will be wiser to leave the diagnosis for some time in suspense.

The laryngeal excrescences of syphilis and of phthisis can hardly be mistaken for non-malignant new formations. The existence of condylomata of the larynx is still doubted by many competent observers. The submucous origin of gummata, which are also very rare, and which occur in the form of smooth, roundish, yellowish, or pinkish elevations, is very obvious even on casual observation. The so-called 'false excrescences' of laryngeal syphilis, which, it is true, resemble in form some genuine neoplasms, but which in reality only represent ragged borders of ulcers seen *en profile*, are distinguished by being almost always situated in the interarytænoid fold — a situation in which, as stated above, according to the experiences of the most trustworthy observers, genuine neoplasms are never found. Moreover, in such cases there will be either concomitant lesions in other parts, or scars pointing to old mischief of a specific nature, and the history as well as the use of antisyphilitic remedies will soon clear up the diagnosis.

The general tumefaction, soon followed by ulceration, of laryngeal tuberculosis, coupled, as it almost always is in such a stage, with evidence of pulmonary disease and constitutional symptoms, will hardly lead the most inexperienced observer to mistake it for a benign growth.

Treatment.—There are cases of laryngeal growths, in which small neoplasms (especially fibromata) are so situated as to cause very little or no inconvenience. In such cases, operative removal may certainly be dispensed with, and the patient ought only to submit himself periodically to inspection, in order that the progress of the growth may be kept under notice.

In the much more numerous cases, in which neoplasms cause greater inconvenience or even danger, operative interference is indispensable. It has already been mentioned (see *Chronic Laryngitis*, under LARYNGITIS) that treatment of well-defined neoplasms by astringent or caustic applications is not only useless, so far as the destruction of the growth is concerned, but even injurious to the healthy parts in their neighbourhood. Moreover, the introduction of strong caustics into the larynx always implies a certain risk, leading, as it often does, to spasm of the glottis, and sometimes to violent inflammation of the adjacent parts.

Thus, removal of the growth is left as the only efficient mode of treatment. Such removal can either be effected from within under the guidance of the laryngeal mirror, or from without—i.e. by opening the laryngeal cavity; or, in rare cases, by a combination of these two methods—viz. tracheotomy, followed by intralaryngeal removal. The question which of the two methods, the intralaryngeal or the extralaryngeal, is the preferable one has been hotly discussed for years, and even now no general consensus of opinion has been obtained, though undoubtedly the intralaryngeal method is in the ascendant. It is impossible in the limited space at the writer's disposal to discuss the merits of both methods at any length. He unhesitatingly gives the preference to the intralaryngeal removal in all cases in which its execution is feasible, and his experience has taught him that this is possible in most cases. It has been contended that some qualities of certain growths, such as broad bases, vascularity, hard consistence, subglottic position when large, multiplicity and tendency towards recurrence, formed so many contra-indications to the adoption of the intralaryngeal method. The writer's personal experience has convinced him, that even the joint occurrence of several of these conditions in one case, often presents no insuperable obstacle to successful intralaryngeal extirpation. Of course, if there be urgent dyspnœa, and immediate intralaryngeal relief be unobtainable from whatsoever cause, palliative tracheotomy ought to be performed; but the writer would strongly advise that the division of the thyroid cartilages in such cases be not proceeded with at once, on account of the serious danger of lasting impairment of the voice which, in the majority of cases, follows the performance of that operation. *See* THYROTOMY.

Here comes in the vexed question of the recurrence of multiple papillomata. It has been maintained that thyrotomy offered, apart from being a quicker method of treatment than intralaryngeal evulsion of the growths, a better chance of thoroughly removing all of them, and of effectually cauterising their bases, thus giving a greater protection against recurrence. To this it must be replied that the uncontroverted statistics of Professor Bruns of Tübingen have shown these statements to be altogether unfounded on fact, and that they have brought out, in addition, most clearly the important fact that thyrotomy is in itself an operation seriously jeopardising the voice. The writer would add that frequently, in this question, two very different conditions are confounded under the one name 'recurrence.' It is an altogether different thing whether, from the same place from which a papilloma has just been removed, a fresh one springs up; or whether, after the removal of a papilloma from the anterior commissure of the vocal cords, another one begins to grow from one of the laryngeal ventricles. The latter event is evidently no 'recurrence' in the proper sense of the word, though often wrongly thus denominated, but evidence of a tendency to general papillomatous degeneration. It is obvious that unless, under such circumstances, all the contents of the laryngeal box be cut out or the larynx be entirely extirpated—two proceedings against the performance of which in such cases the writer would emphatically protest — no operation can give a guarantee against the appearance of fresh growths in the larynx. But it is equally obvious that, under such circumstances, the performance of an operation ought to be avoided, which, like thyrotomy, carries with it a grave danger of lasting impairment to the voice. The writer has found that if, in cases of multiple recurring papillomata, the intralaryngeal removal be perseveringly proceeded with, almost always, finally, a time arrives when the tendency to a fresh formation of these growths appears to become exhausted. The statement, that protracted intralaryngeal operations have been instrumental in converting a benign into a malignant tumour, has never been supported by valid evidence.

As to the practice of intra-laryngeal operations, the writer considers it neither necessary nor even desirable to give detailed directions. The method can only be learned by continued practice on the living subject, not from mere descriptions; its very essence—viz. that the operator must constantly transfer, in his mind's eye, the parts seen in the antero-posteriorly *inverted* image to their real position—demanding quite a special education. The recent introduction of hydrochlorate of cocaine as a local anæsthetic of the laryngeal mucous membrane—a 20 per cent. solution being applied by means of a camel-hair brush to the larynx five minutes before the operation, and this application, if necessary, being repeated once or oftener during the sitting—will no doubt greatly facilitate the more general adoption of the intralaryngeal method. Removal of growths may be effected by cutting, by crushing, by evulsion, and by galvano-cauterisation, but it is impossible to lay down any general rule as to the method to be employed. The writer has found, in the great majority of his cases, that evulsion by means of Mackenzie's cutting laryngeal forceps did all that was necessary; in certain difficult cases, the galvano-caustic loop and burner had to be resorted to. Voltolini's method—viz. of running a little sponge firmly attached to a laryngeal probe up and down the larynx, by which process soft growths are supposed to be torn off their attachments—has not proved very satisfactory in his hands.

B. Malignant Growths. — *Causes.*— The causes of the origin of malignant growths in the larynx are as obscure as those of such growths in general. It is generally believed that hereditary influences, traumatic lesions, and long-continued irritation of the vocal organ may play a *rôle* in their production; the writer, who has had the opportunity of seeing an unusually large number of these neoplasms, has not been able, in a single case, to trace the origin to a distinct cause. It is doubtful whether papillomata ever degenerate into cancroids. Malignant tumours of the larynx almost always belong to the period of life after forty; the writer has seen two cases in men over eighty. The male sex is more liable to the disease than the female.

Pathology.—The malignant neoplasms met with in the larynx are carcinomata and sarcomata. Of these, the latter are very rare, the former considerably more frequent than is generally supposed. Carcinoma of the larynx is almost always primary or contiguous, never—so far as the writer knows—metastatic or infectious. This is due to the peculiar arrangement of the lymphatics of the larynx. They are very richly developed, but form quite a network of their own, and without anastomosing with the lymphatics of the neighbouring parts—as do the pharyngeal lymphatics so amply—empty themselves into four small lymphatic glands, two of which are situated underneath the greater horns of the hyoid bone, the two others at the sides of the trachea. This is practically very important, for it explains, on the one hand, why the larynx enjoys a practical immunity from infection in cases of carcinoma elsewhere in the body; on the other, why, in cases of primary intrinsic carcinoma of the larynx, the disease so long remains a purely local one, and does not infest the neighbouring lymphatics of the neck. Similar conditions obtain in laryngeal diphtheria. Hence, also the marked absence of general cachexia in the first stages of intrinsic laryngeal carcinoma.

Cancer of the larynx appears by far most frequently in the form of epithelioma, much more rarely as medullary carcinoma, still more rarely as scirrhus; the histological characteristics of these forms being the same in the larynx as those seen elsewhere in the body. The seats of predilection of laryngeal carcinoma are the ventricular bands and vocal cords. Sarcoma occurs in the round-celled, less frequently in the spindle-celled form.

Symptoms.—It is often very difficult, in the early stages of malignant neoplasms of the larynx, to differentiate them from benign ones or even from other laryngeal affections, neither the subjective nor the objective symptoms being of a pathognomonic character. Hoarseness is usually the earliest and altogether the most constant symptom. Its degree in the earliest stages—i.e. when only a small projection is seen on one of the vocal cords—is often out of proportion to the size of the neoplasm; and the writer considers it as a sign of great importance if already, at this early period, the mobility of the affected cord is considerably impaired. The latter phenomenon, which is no doubt due to the infiltrating character of the tumour, is entirely absent in cases of benign growths of similar size. With the progress of the tumefaction, the hoarseness soon changes into complete aphonia; but, on the other hand, the voice, which was already entirely lost, sometimes returns to some extent at the time when the tumour begins to break down—i.e. when a better juxtaposition of the cords is again rendered possible. Pain in the larynx may occur either at an early or at a later period, but the writer has observed cases in which this symptom was almost entirely absent throughout the course of the disease. If present, it may radiate from the throat to the ear, the irritated fibres of the superior laryngeal nerve transmitting the irritation to the auricular branch of the pneumogastric nerve; but this variation of pain is not pathognomic of laryngeal cancer. The laryngeal region is not infrequently tender on external pressure. Dysphagia is always present when the epiglottis and the arytæno-epiglottidean folds are the seat of the disease; in intrinsic carcinoma it often is absent or slight. There is nearly always a considerable increase of secretion. This is generally at first frothy, later on tenacious and semipurulent, not rarely streaked with blood; in later stages—i.e. when the perichondrium has become affected—often fetid, as is also the patient's breath. More or less considerable hæmorrhages not infrequently take place, when vessels have been laid open in the progress of the disease. As soon as the tumefaction considerably narrows the air-passages, dyspnœa makes its appearance, the degree of which depends upon the amount of obstruction caused. Cachexia is not rarely absent throughout until the patient's death, and the lymphatics of the neck often remain unattacked so long as the growth remains within the larynx proper; when, however, the cancer dips into the pharynx, tumefaction of the lymphatics underneath the sterno-cleido-mastoid muscles and of the posterior cervical lymphatics sometimes takes place. In late stages of the intrinsic variety, the larynx is sometimes found considerably broadened, in consequence of the pressure from within.

In those cases in which the disease attacks the larynx only by contiguity—i.e. in which it starts from the tongue, the pharynx, the œsophagus, the thyroid gland, the branchial fissures of the neck, &c.—the symptoms just enumerated will of course vary according to the primary seat of the cancer, and will be, moreover, complicated by symptoms peculiar to the affection of the part primarily infested. Not rarely, acute œdema of the parts in the immediate vicinity of the new growth sets in; more frequently there is some degree of chronic œdema around the tumour. In other cases the perichondrium and the cartilages themselves are attacked, necrosis of the cartilages takes place, abscesses are formed, parts of the cartilages become separated and may be expectorated, fistulous communications between the air and food passages are established, or between the larynx and the external neck, &c.

The laryngoscopic appearances in the early stages are not very characteristic, and it will be often found very difficult to differentiate commencing carcinoma or sarcoma from papilloma, fibroma, syphilitic or tubercular infiltration. Generally, malignant growths appear as cauliflower-like, semiglobular, mamillated or warty distinct protuberances; in some cases there is from the beginning more extensive infiltration, with but little projection above the surface. Later on, the extensive irregular tumefaction, which sometimes fills half or even the whole laryngeal cavity and invades all the laryngeal structures, and above all the ulceration of the tumour itself, make the appearances much more characteristic. If the disease starts from the epiglottis, that part may either be found immensely thickened or, in other cases on the contrary, almost entirely eaten away. The parts are almost always found covered by white, yellowish, or greenish slimy or muco-purulent, often fetid, secretion.

Diagnosis.—Malignant growths of the larynx may be mistaken—(*a*) for benign ones; with regard to the differential diagnosis between the two, see *Non-Malignant Growths*, Diagnosis; (*b*) for syphilitic affections. The differential diagnosis is often difficult. The previous history of the patient, the simultaneous existence of other syphilitic affections, or evidence of old syphilitic lesions in other parts of the body, will of course aid in the decision, but neither is absolutely reliable. The carcinomatous ulcer, as well as the syphilitic, is irregular, and in the neighbourhood of both there is a zone of inflammation. But the syphilitic ulcer in the larynx is generally developed very acutely, often within a few days, whilst the cancerous takes some weeks for its development. The former is almost always solitary, unilateral, and not very large; the latter is preceded by tumefaction, the traces of which remain round the ulcer. Frequently, it is covered with small excrescences, and often attains a very large size.

There are, however, cases in which all these diagnostic signs are of little value, and in these the use of iodide of potassium will often solve the doubt. The writer would propose it as a general rule, that the treatment of every case of suspected laryngeal cancer ought to begin with the administration of large doses of iodide of potassium. (Ten-grain doses three times daily, to be rapidly increased up to thirty-grain doses three times daily.) No conclusions as to the nature of the affection ought to be drawn from the patient's statements, but only from the occurrence of actual changes for the better in the laryngeal appearances; for the writer has found that, even in cases of undoubted cancer of the larynx, the patients often state, after having taken iodide of potassium for a week's time, that they feel better. In such cases, however, the progress of the growth is of course not arrested, and the drug soon loses its effect upon the subjective sensations.

(*c*) Malignant disease of the larynx may also be mistaken for tubercular affections. Here, generally, the differential diagnosis is much easier. The patient's age, the concomitance of pulmonary affections, the characteristic pallor of the laryngeal tissues, the bilateral infiltration usual in laryngeal phthisis, the slow development of the ulcers, their small size and great number, will easily differentiate this affection from malignant growth in the larynx. Examples have, however, been recorded by good observers, in which mistakes have been committed.

Treatment.—The treatment of malignant growths of the larynx is very unsatisfactory. Medical treatment is of course useless. Pain may be temporarily relieved by insufflations of morphia (gr. $\frac{1}{8}$—$\frac{1}{2}$ twice daily or more frequently). It is probable that applications of strong cocaine solutions (20 per cent. or more) to the affected parts, or the use of cocaine-sprays and tablets will also, in this disease, relieve pain and dysphagia, but up to the moment when this was written no experiences regarding this point had been recorded. If there be complete impossibility of swallowing, the patient must be fed by the stomach-pump or by nutrient enemata, unless gastrostomy be preferred. Dyspnœa being almost always present, the writer would advise the performance of tracheotomy, as far as possible from the seat of the disease, at an early period—i.e. before the general health has already suffered from insufficient air supply. The operation affords great relief to the patient, and life is prolonged on an average for a year, and not infrequently for longer. If its performance be left until the patient is almost suffocated, the results are not nearly so satisfactory.

Regarding radical extirpation of the growth, the following modes of procedure have to be considered: (1) intralaryngeal extirpation; (2) thyrotomy; (3) subhyoid pharyngotomy; (4) total—(5) partial extirpation of the larynx.

(1) Intralaryngeal extirpation is out of the question in cases of carcinoma, and in sarcoma may only be attempted in those cases in which the neoplasm forms a well-defined tumour.

(2) Thyrotomy, with subsequent extirpation through the wound, yields very bad results in cases of malignant growth, and should not be attempted.

(3) Subhyoid pharyngotomy may be thought of, in cases in which the growth is limited to the epiglottis and the parts in the laryngeal vestibule.

(4) Total extirpation of the larynx for carcinoma is at present still on its trial. According to the latest statistics, out of sixty patients operated upon for carcinoma, forty-two died, fifteen recovered, and the end of three cases is unknown. This result is certainly not very encouraging; and the question of how long the patients who recovered survived the operation, and the proportion between the length of life after simple tracheotomy and that after successful extirpation of the larynx, have still to be determined. Until these questions have been fully answered by large and reliable statistics, the propriety of extirpating the larynx as soon as the diagnosis of laryngeal cancer has been established is, in the writer's opinion, still *sub judice.* On the other hand, it is only in cases in which the tumour is absolutely limited to the laryngeal cavity, and in which no affection of the neighbouring parts is as yet present, that an early operation appears to have any chance. For, in those cases in which the lymphatic glands, the pharynx, œsophagus, thyroid gland, &c., are simultaneously or even primarily attacked, it will be almost impossible to eradicate all traces of the malignant disease, and recurrences within the next few months are almost certain. The kind of life which the patient will have to lead even after successful operation, and even with an artificial larynx, must of course be fully explained to him before the operation is undertaken. In sarcoma, the chances of complete extirpation appear to be much better. One patient has certainly survived the operation for more than six years.

(5) Partial extirpation of the larynx has of late years repeatedly been performed, especially by German surgeons, in cases in which the disease only involved one half of the larynx. It is stated to be much less serious than the total excision, not to be followed more frequently by recurrence of the disease than after complete removal of the organ, to give rise to less functional disturbance with regard to swallowing and speaking, and, in some instances, even to

enable the patient to dispense later on with the tracheal tube. Further experience, however, will have to show how far these statements can be supported. In the present state of our knowledge, the best policy would appear to be to explain to the patient or to his friends, on the one hand, the chances of the palliative treatment (tracheotomy if necessary, accompanied or followed by gastrostomy); and, on the other, those of the radical (partial or total extirpation of the larynx), and to let them decide. *See* Larynx, Extirpation of the.

Felix Semon.

LARYNX, Neuroses of the.—A. Motor Neuroses.

I. Paralyses. — *Causes.* — Diminished or abolished action of the vocal cords may be the consequence of either a neuropathic or a myopathic impairment. Myopathic impairments may be due to muscular degeneration (in phthisis), to infiltration of the muscles (in inflammatory processes), or to their direct destruction (in cases of injury, malignant growth in the larynx or œsophagus, &c.); otherwise they are exceedingly rare. Neuropathic impairments may be either of an organic or of a functional nature. The latter class of cases includes functional weakness (in cases of phthisis, chlorosis, general anæmia, loss of blood after injuries, exhausting diseases, &c.), hysterical affections; and—at least in the initial stages—also the *reflex* paralyses, although, in the case of the latter, probably later on actual organic changes take place. Examples of such reflex paralyses would be: the paralysis resulting on the *opposite* side from pressure on one pneumogastric nerve, probably some instances of diphtheritic and possibly some of the forms of toxic paralysis. The reflex paralysis in the first-named class of cases has been ingeniously explained by Dr. George Johnson as the result of a centripetal irritation of the trunk of the vagus acting on the nervous centre, and through it upon the nerve-supply to the laryngeal muscles on the opposite side.

With the exception of some of these reflex paralyses, in the great majority of cases of functional paralysis the adductor fibres of the recurrent laryngeal nerves are concerned, very rarely the abductor fibres. The organic paralyses may be of a central, peripheral, perhaps also (*see* above) of reflex origin. These paralyses may be either complete or incomplete—i.e. they may either involve the whole of the motor centres or single motor nerves of the larynx, or they may be limited to parts of centres or nerve-trunks. Thus, in cases belonging to the last-named category, there may be either paralysis of the motor branch of the superior laryngeal nerve, or incomplete paralysis of the centres or trunks of the recurrent laryngeal nerves, or paralysis of individual twigs of the recurrent from local causes. In cases of incomplete organic lesion of the centres or trunks of the spinal accessory, pneumogastric, and recurrent laryngeal nerves, there is, as the writer has shown, a distinct proclivity of the abductor fibres of the recurrent laryngeal nerve to succumb sooner than the adductor fibres, or even exclusively; whilst the occurrence of an analogous isolated affection of the adductor fibres, in cases of organic disease, has never yet been verified.

Pathology.—In the purely functional cases, no changes are to be detected in either nerves or muscles; in the myopathic cases, the changes vary according to the fundamental cause. Thus, in cases of acute inflammation of the mucous membrane, a serous infiltration of the muscles may take place, in phthisis, fatty degeneration of the muscles may be found, whilst in a case of œsophageal carcinoma occupying the plate of the cricoid cartilage, one or both posterior crico-arytænoid cartilages may have partially or entirely perished by a process of invasion and ulcerative destruction. In cases of neuropathic paralysis due to organic lesion or disease of the motor laryngeal nerves, the atrophic and degenerative changes usually met with under such circumstances will be found in the nerves and in the muscles supplied by them, their intensity varying in proportion to the amount of the lesion. If the lesion be equivalent to a transverse section of the nerve affected, all the nerve-fibres and all the muscles supplied by the nerve will, of course, suffer in an equal degree. But it is a most remarkable fact that, even in cases of grave and long-standing implication of the recurrent laryngeal nerves in tumours or dense connective tissue, or of serious central disease involving the roots of the laryngeal motor nerves, a number of normal, well-preserved nerve-fibres has been found; and that, in such cases as stated above, the abductors of the vocal cords (posterior crico-arytænoid muscles) have invariably been found to have undergone considerable or even almost complete atrophy and fatty degeneration, whilst the adductors have either suffered to a much less degree or even entirely escaped degenerative changes.

Symptoms. — The larynx serves two functions, respiration and phonation. For the former it is necessary that the glottis should be open to a certain extent during inspiration and expiration, for the latter that it should be closed during the act of speaking, and that there should be a certain amount of tension of the vocal cords. If, in consequence of impaired abductive power, the cords cannot separate so far as to allow of a sufficient entry of air during inspiration, dyspnœa will arise; if, on the other hand, in consequence of complete paralysis of one or both recurrent laryngeal nerves, or of their adductor or tensor twigs, the vocal cords cannot be brought fully together or are not in a sufficient degree of tension when brought together, aphonia or dysphonia will arise.

The symptoms of laryngeal paralysis, therefore—apart from the symptoms of the fundamental disease which causes the paralysis—will vary very considerably according to the set of fibres attacked, and also according to whether the paralysis is unilateral or bilateral.

In *unilateral complete paralysis of one recurrent laryngeal nerve* the corresponding vocal cord stands immovably in the so-called cadaveric position—i.e. according to the measurements of the writer, about two to three millimètres from the mesial line. The other cord moves freely, and often, on attempted phonation, even crosses the middle line to join its fellow, the position of the glottis under such circumstances being oblique. The voice may be entirely lost, or impaired, squeaking, and with a peculiar tendency to breaking into falsetto on the slightest phonatory effort. There is no dyspnœa.

In *bilateral complete paralysis of the recurrent laryngeal nerves* both vocal cords stand immovably in the positions they occupy after death (cadaveric position), the voice is entirely lost, on attempted phonation the air rushes through the open glottis, and the patient soon gets exhausted if he attempts to speak, cough, or expectorate. There is no dyspnœa during repose; shortness of breath only occurs on exertion.

It has been stated above that, in case of incomplete organic unilateral paralysis of a recurrent nerve, those of its fibres which supply the abductor muscle are always first or pre-eminently paralysed. In such cases, there is at first of course only impaired abduction on the affected side; later on, however, the unopposed antagonists of the paralysed muscle fall into a state of paralytic contraction, and draw the vocal cord into the position of phonation, where it becomes immovably fixed. Under such circumstances—i.e. in the initial stages of all the severe lesions (enumerated under 'Causes') which may implicate the laryngeal nerves, and indeed not rarely up to the patient's death—in adults *neither vocal nor respiratory symptoms occur*; and the important laryngeal lesion present, which may be of the greatest importance for the correct diagnosis of the whole case, will entirely escape notice, unless a rule be made to examine the larynx in all cases in which lesions of the laryngeal nerves could occur, whether there be symptoms pointing to the larynx or not. In children, in consequence of the smallness of the glottis, even in unilateral paralysis of an abductor, fatal dyspnœa may arise.

If the conditions named in the last paragraph obtain on both sides—i.e. if there be either a bilateral incomplete lesion of the centres (e.g. in cerebral syphilis, or in tabes, or in a case of tumour of the brain); or a similar incomplete lesion of the trunks of both recurrent laryngeal nerves (e.g. in cases of goître, aneurism of the aorta, carcinoma of the œsophagus); or if there be pressure upon the trunk of one pneumogastric nerve only (*see* under 'Causes'), the result will be *bilateral paralysis of the abductors of the vocal cords.* In such a case both vocal cords will, in the manner above described, be gradually drawn towards, and finally be fixed near, the middle line. Laryngoscopically, this looks similar to a continuous position of phonation. On inspiration, the cords separate to the extent of a small rim between their inner borders, or are, in much developed cases, even drawn nearer each other by the rarefaction of air below the stenosed opening; on expiration they separate a very little as in inspiration; on phonation they come together as under normal circumstances. The result of this state of things is loud, often sonorous, inspiratory stridor, free and noiseless expiration, and normal voice. There is always in advanced cases dyspnœa, but its intensity greatly depends upon whether the stenosis has been produced gradually or more suddenly. In the former cases, it is often surprising how little subjective dyspnœa is experienced by a patient whose glottis is reduced to a diameter of not more than two to three millimètres It is obvious that, in such patients, the least swelling of the abnormally approximated parts will suffice to close the opening, and may lead to immediate asphyxia.

Paralysis of the *adductors* is almost always bilateral and due to functional disorders, especially to weakness of the muscles (as in phthisis, chlorosis, &c.), to infiltration of the muscles (as in violent catarrh or inflammation of the air-passages), to reflex causes (uterine disorders, &c.), and to hysteria. If unilateral, in which case one vocal cord would be seen not to approach the middle line on attempted phonation, whilst on deep inspiration it would be properly drawn to the side of the larynx, it is probably always the consequence of *local* injury to nerve-twigs or muscles. The voice would probably be quite aphonic, or at least exceedingly hoarse. In the bilateral cases the paralysis is rarely complete, in which case the glottis will be seen to form, on attempted phonation, a widely open immobile triangle, more frequently incomplete—i.e. on attempted phonation the cords are seen to approach, without, however, completely closing the glottis, or, if they do so, they at once recede from their juxtaposition. Thus this form is, more correctly speaking, a paresis. The result of the deficient closure of the glottis is more or less complete aphonia. Sometimes the patient is able to produce a few sounds with resonant voice ; more often this is impossible ; but even if the voice has been lost for months or years, coughing, sneezing, and the emotional voice-sounds (laughing, sighing) are often found to still possess their normal character. The onset of the affection is in the hysterical cases quite sudden, its duration most variable (from hours to years), its end sometimes quite as sudden as its beginning. In cases of catarrhal origin, both beginning and passing off are, in accordance with the nature of the lesion, more gradual.

Sometimes, in cases of catarrh or of hysteria, the *inter-arytænoid* muscle alone is affected. In such cases, the anterior three-fourths of the vocal cords are seen to come together on attempted phonation, but a triangular space remains open in the hindermost part of the glottis. In such cases there may be complete aphonia. The writer has never seen a case of isolated paralysis of a *crico-arytænoideus lateralis* ; and though, of course, its occurrence in consequence of local lesion is theoretically quite possible, he must confess that he would be unable to distinguish it from paralysis of all the adductors on the same side.

Isolated paralysis of the *internal tensors* (thyro-arytænoid muscles) is laryngoscopically shown by an elliptic cleft remaining between the inner borders of the vocal cords on attempted phonation, and may be accompanied by more or less loss of voice. It is often associated with, or quickly follows upon, paralysis of the glottis-openers. It is, however, important to know that some elliptic gaping of the vocal cords, during phonation, is by no means rarely seen in persons who are in full possession of their voice.

Isolated paralysis of the *external tensors* (crico-thyroid muscles) may occur after diphtheria, and is, according to Mackenzie, characterised by the glottis having a wavy outline. There is, the same author states, a slight depression of the central portion of the vocal cords in inspiration, and a corresponding elevation in expiration and vocalisation. In unilateral paralysis of a crico-thyroid muscle, the corresponding vocal cord stands on a higher level than its fellow. The symptoms met with under such circumstances are more on the side of the sensory fibres of the superior laryngeal nerve (see *Neuroses of Sensation*) than of its motor fibres ; but probably a deep, gruff, monotonous voice would be present.

Finally, it may be remarked that combinations of paralyses of individual muscles, with corresponding variations of the laryngoscopic image, are sometimes met with.

Diagnosis.—A certain diagnosis of laryngeal paralysis can only be made by means of the laryngoscope. Although, in cases of hysterical paralysis of the adductors or of bilateral paralysis of the abductors, the symptoms are so characteristic as to leave little doubt as to the nature of the loss of voice in the one and of the inspiratory dyspnœa in the other ; yet the conditions in the former case may be simulated by general respiratory weakness, laryngeal polypi, and other forms of mechanical impediment to the closure of the glottis, in the latter by spasm of the glottis, perverse action of the vocal cords, cicatricial contraction in the inter-arytænoid fold (*see* Larynx, Syphilis of the), and, to a certain degree, by gummatous infiltration and stenosis of the trachea. Serious errors in these respects are known to have been made. In all forms of laryngeal paralysis, the laryngoscope will therefore be well-nigh indispensable for diagnosis. The mere discovery of an immobility of one or both vocal cords, however, is not sufficient to at once establish the diagnosis of a ‘ paralysis ; ’ and the surgeon must bear in mind the possibility of a mechanical fixation by cicatricial contraction of the mucous membrane, after ulcerative diseases or injuries. A very unusual position of the arytænoid cartilage and corresponding vocal cord, with absolute immobility, signs of previous ulcerative diseases, abnormal distortion of the mucous folds, and above all, tumefaction at the base of the immobile arytænoid cartilage, will favour the idea of a mechanical fixation. Several affections may lead to either mechanical fixation or to nervous paralysis, and the possibility of the combination of both forms of impairment must not be lost sight of. If the diagnosis of nervous paralysis have been established, its fundamental cause must of course be sought for.

Treatment.—In any form of *organic* laryngeal paralysis, the only indication is to remove, if possible, the *cause* of the mischief. Thus, in cases of cerebral syphilis a most energetic anti-specific treatment will have to be instituted; in cases of pressure by glands or tumours, these will, if possible, have to be removed, &c. Direct treatment of the paralysis itself, by electricity or otherwise, is, so long as the exciting cause continues to act, perfectly useless, though faradisation of the paralysed nerves and muscles, coupled with hypodermic injections of sulphate of strychnia (dose gr. $\frac{1}{30}$ gradually increasing to gr. $\frac{1}{10}$), may with advantage be adopted after its removal, in the hope that the conductivity of the nerve has not yet been wholly destroyed. In cases of bilateral paralysis of the abductors, in which considerable stenosis of the glottis has taken place and marked dyspnœa is present, unless not only subjective relief but an actual enlargement of the glottic opening has been speedily obtained by whatever method is employed, tracheotomy ought to be performed without delay; not as a curative but as a prophylactic measure, with a view to the subsequent removal of the tube in case any later therapeutical efforts should produce a real cure of the affection. Here, however, one caution is necessary. In all cases in which there is bilateral paralysis of the glottis-openers, certainly or probably due to pressure upon the nerves by tumours of the neck or thorax, it will often be impossible, with the means at present at our command, to exclude with certainty the existence of *a second stenosis lower down*, due to direct compression of the trachea or of the bronchi by the same tumour which causes the paralysis. If the laryngeal narrowing be considerable enough to give a sufficient explanation of the patient's dyspnœa, the surgeon will be warranted in operating, but he should always beforehand fully explain the situation to the patient or to his friends, to prevent disappointment in case there be a second stenosis lower down. Under such circumstances the low operation should always, if possible, be chosen, so that in case of a second stenosis lower down the tube could either be inserted below the compressing tumour—in cases of tumour of the neck—or that a long, flexible tube might be cautiously passed down, if possible, through the narrowed part of the windpipe, especially in cases of intra-thoracic tumours.

In cases of functional paralysis of the adductors, through overwork of the part or general or local weakness, tonic treatment (iron, phosphorus, strychnia, arsenic) coupled with gentle galvanisation or faradisation over the region of the pneumogastric nerves is indicated. Rest of the voice should be enjoined. In cases of inflammatory origin the usual treatment of catarrh might be instituted. *See* LARYNGITIS. In reflex paralysis the distant cause (e.g. uterine trouble) ought to be looked for and appropriately treated. In hysterical paralysis of the adductors, emotional effects or anything that gives a shock to the system often produce a cure, and the same result is frequently obtained by any remedy that stimulates the laryngeal mucous membrane —e.g. by inhalation of ammonia. The most reliable and quickest method, however, consists in intra-laryngeal faradisation by means of Mackenzie's laryngeal electrode. Generally, even in long-standing cases, the voice can be restored in the first sitting. The shock given ought not to be too great, nor, on the other hand, too feeble. By timid handling of the method its effects are often spoiled, and its subsequent adoption rendered difficult. If necessary, the faradisation ought to be repeated; in the writer's experience, however, one strong application generally suffices.

In post-diphtheritic paralysis of the crico-thyroid muscles, faradisation to the muscles and hypodermic injections of sulphate of strychnia into the sides of the neck are recommended.

II. SPASMS.—*Causes.*—Excessive action of the laryngeal nerves may be due either to affections of the nerve-centres, nerve-trunks, or of single nerve-twigs. With regard to the nerve-trunk affections, it may be stated that, it having been shown that stimulation of the peripheral end of the cut recurrent laryngeal nerve—i.e. of *all* its fibres—results in adduction of the corresponding vocal cord, it is quite possible that, in cases of so-called 'spasm of the glottis' of peripheral origin, not only the adductors, but also the abductors may be in a state of spasmodic contraction, the former, however, preponderating. In spasms due to affection of single nerve-twigs, either the abductors, or the tensors, or the adductors alone may be concerned. In the case of the latter, the spasm may either occur independently of volition, and may then be (*a*) uninterrupted during the attack (common 'spasmus glottidis'); (*b*) occurring in separate contractions quickly following one another and associated with similar contractions of other expiratory muscles (nervous 'laryngeal cough'); or it may occur only on attempted phonation, when it is usually allied to spasm of the tensors ('aphonia spastica'—'speaker's cramp').

Excessive action is always the result of irritation. Such irritation may be either direct or reflex—i.e. either acting upon the motor nerves themselves or affecting other centripetal nerves, and, being transferred to the laryngeal motor centres, radiate along their centrifugal tracts, causing spasmodic contraction of laryngeal muscles. To produce spasmodic motor phenomena, the irritation must possess a certain degree of suddenness and intensity. Any of the causes usually leading to progressive paralysis of the laryngeal nerves (see *Paralyses*, Causes), may therefore, if acting more suddenly and more intensely, produce laryngeal spasm. Thus, even in a case of slowly progressive primary paralysis of laryngeal nerves, provided that the conductivity of all the fibres has not yet been destroyed, spasm may suddenly supervene, if from any cause there be a sudden increase of irritation.

Pathology.—Laryngeal spasms are in the majority of cases pure neuroses, and, with the exception of those cases in which a direct pressure upon the laryngeal nerves is shown by the post-mortem examination to have existed, no changes either in the nerves or in the muscles are to be detected.

Symptoms.—The symptoms in cases of spasm due to affection of the nerve-trunks, and of the common form of the affection of the adductor twigs in which the contraction is uninterrupted during the attack (common spasm of the glottis), are identical, they may therefore be described together. The symptoms, however, differ to some extent in the cases of children, when the affection is also called 'laryngismus stridulus,' and in those of adults.

In children, often without any preliminary symptoms, a few at first short, gradually more prolonged, stridulous inspirations are followed by closure of the glottis, suspension of the respiratory movements of the chest, and complete cessation of respiration. This cessation, unless the child succumbs during the attack, lasts from a few seconds to about two minutes, and ends with a series of stridulous inspirations, after which regular respiration is gradually re-established. During the attack the aspect is a most painful one: the countenance is very anxious, the flush at first present on the face is soon replaced by pallor or even lividity, the eyes stare, the pupils are contracted, the nostrils are dilated, the head is thrown back, the neck forward, the face is covered with cold perspiration, its veins and those of the neck are swollen, and in severe cases these symptoms are accompanied by spastic, so-called 'carpo-pedal,' contractions of the muscles of the extremities. The thumbs are flexed on the palms and the other fingers closed round them or rigidly extended, the carpal joints are bent inwards, the feet somewhat flexed and rotated inwards. General convulsions are sometimes superadded to these phenomena. Attacks of this sort, but of variable severity, may follow one another at variable times. Sometimes they occur in most rapid succession, sometimes at intervals of twenty-four hours or more. The child may succumb in any of them, whilst in most cases, after a variable duration of the liability to such attacks, a complete cure is finally effected.

In adults the symptoms are similar to those just described, only generally less severe. The complete cessation of respiration witnessed in children only rarely occurs, and the attack is generally characterised by a series of stridulous inspirations. There is no doubt, however, that in cases of sudden considerable irritation of the laryngeal motor nerves, a laryngospastic attack may also end fatally in adults. In very rare cases there is, according to some authors, a slight but constant spasm. A laryngoscopic examination during the attack will, in most cases, be impossible. In the free interval, generally, no abnormality, except perhaps slight congestion, can be detected.

In the variety in which the spasmodic closure appears in the form of separate, sudden, short contractions of the adductors associated with similar contractions of other respiratory muscles, the only symptom is incessant cough of a particularly loud, sometimes barking, nature, which goes on without interruption whilst the patient is waking, and occasionally prevents him from sleeping. This nervous laryngeal cough, which is not associated with any demonstrable lesions, usually attacks young people between 16 and 20, may last for weeks, months, and even years, and finally almost always disappears spontaneously.

The last form of spasmodic contraction of the adductors, which is probably always allied to a similar contraction of the tensors, only occurs on attempted phonation, and is called 'spastic aphonia.' This form, like the preceding, is rare. There appears to be a certain proclivity to it on the part of highly strung male persons who have to use their vocal organs professionally (especially clergymen), but apparently robust males and females, whose occupation is of a silent kind, may also be attacked. It is characterised by a very peculiar alteration of the voice. Whenever the patient attempts to speak, he produces only a few sentences, words, or even syllables, in an audible voice, the rest of the sentence or word being completely lost in fruitless and distressing efforts to force a current of air through the spasmodically closed glottis. Laryngoscopically, under these circumstances the glottis may be seen to be so spasmodically closed, that it almost appears as if one vocal cord were overlapping the other. When the patient whispers, the difficulty is sometimes not so great, though not entirely absent. Respiration is free and noiseless.

Diagnosis.—Spasm of all the laryngeal muscles or of the adductors alone is so well characterised by its sudden commencement, the complete cessation of respiratory movements at the height of the attack, the absolutely free intervals, the absence of fever, cough, hoarseness, or aphonia, that these points considered together will, on the whole, suffice to prevent the practitioner from confusing it with acute laryngitis, &c.

Nervous laryngeal cough can only be confounded with cough from organic disease (phthisis). Careful examination of the chest, &c., will obviate such an error; moreover, cough from organic disease is hardly ever so continuous as the purely neurotic. Aphonia spastica is differentiated from common spasm of the glottis by its occurring only on attempts at phonation; from bilateral paralysis of the abductors by being associated with free and noiseless respiration.

Treatment.—In cases of spasmodic closure of the glottis threatening life, the first indication is to relieve the spasm, the second to remove if possible the cause of the abnormal irritability causing the spasm. During the attack, fresh air must be admitted to the room, the patient should be placed in a sitting posture, all tight clothing ought to be removed from him, cold water dashed into his face and upon his chest, strong smelling salts, ammonia, ether, acetic acid, should be held to his nostrils, and his fauces tickled with the finger or a feather until retching is produced. Inhalation of chloroform (which, of course, ought only to be administered by a medical man), or a subcutaneous injection of morphia often curtails the attack. During the interval, the exciting cause of the spasm ought to be ascertained if possible, in order to be avoided in future. The patient should be protected against all emotional disturbance; gastric and intestinal disorders should be promptly attended to; in cases of rachitis, the general hygiene and diet must be carefully regulated and cod-liver oil be given.

Nervous laryngeal cough and aphonia spastica are equally little amenable to treatment; but the best remedy, especially in nervous laryngeal cough, appears to consist in a long journey (if possible a sea voyage), or removal of the patient from his usual surroundings. In cases of nervous laryngeal cough due to irritability of the laryngeal mucous membrane, cocaine applications may possibly prove useful.

III. Troubles of Co-ordination.—Under this head it is only necessary to remark that, in some cases, a disorderly action of the vocal cords is observed. Thus choreic movements of these parts have been seen to accompany general chorea, and have even been noticed independently; a tremulous action of one or both cords, similar to the tremors of the limbs on intended movement, is sometimes seen in disseminated cerebro-spinal sclerosis, and finally, in some cases, a perverse action of the cords has been described. In this form (which has also been named functional inspiratory spasm, though it is more a trouble of co-ordination than of excessive action), the vocal cords, instead of separating on intended inspiration, approach each other, remain together during the inspiration, so that the air enters with difficulty and accompanied by stridor through the narrowed glottis, and only separate to some extent during expiration. The symptoms in such cases (variations appear to occur) will be very similar to those of bilateral paralysis of the abductors (see *Paralysis*); and it is only by watching the vocal cords with the laryngoscope during expiration, that a separation will be seen and a correct diagnosis arrived at. This affection appears to occur almost exclusively in nervous or hysterical persons, and a minor degree of the same is often witnessed in nervous people who are for the first time examined with the laryngoscope, the vocal cords being in such cases approached to one another, instead of separated, on attempting a deep inspiration. Psychical treatment, bromide of potassium, and the cold douche will often effect a cure.

B. Neuroses of Sensation.

I. Anæsthesia.—Loss of sensibility of the mucous membrane occurs when the sensitive branch of the superior laryngeal nerve is paralysed. This may arise in cases of bulbar paralysis and other cerebral affections, in diphtheria, and to a minor degree in hysteria. It may be unilateral or bilateral, and vary from a slight diminution of sensibility and reflex irritability to complete anæsthesia and analgesia. If occurring in diphtheria or bulbar paralysis, it is always coupled with motor paralysis of the depressors of the epiglottis, and often with paralysis of the crico-thyroid muscles. *See* the motor phenomena caused by this paralysis, under *Paralyses.* The upper aperture of the larynx remaining open during the act of swallowing, and the mucous membrane of the larynx itself being insensitive, under these circumstances particles of food often enter the lower air-passages, and may either cause most violent cough (the tracheal mucous membrane having retained its reflex irritability) ; or obstruct the passage and produce dangerous attacks of suffocation; or become impacted in the bronchi and give rise to pneumonia. A certain diagnosis can only be arrived at by touching the laryngeal mucous membrane, under guidance of the mirror, with a probe. If anæsthesia be present, the patient neither feels the touch nor is reflex cough, &c., produced. Though post-diphtheritic anæsthesia tends to spontaneous disappearance in the course of five or six weeks, in all forms in which the anæsthesia is complete, the patient ought to be fed either by the œsophageal tube or by nutritive enemata, in order to prevent the very dangerous entry of food into the air-passages. The œsophageal tube ought, under these circumstances, to be introduced very cautiously, guided by the forefinger of the left hand, in order that it may not enter into the open and insensitive larynx. When it is in what is supposed to be the correct position, the patient, before the food is administered, should be requested to produce a sound, which will be impossible when the instrument is in the trachea. As to the treatment of the affection itself, in diphtheritic paralysis galvanic and faradic electricity applied to the anterior wall of the pyriform sinus, close to which the superior laryngeal nerve is running, and hypodermic injections of sulphate of strychnia (gr. $\frac{1}{30}$ to $\frac{1}{10}$) are recommended.

II. Hyperæsthesia, Paræsthesia, and Neuralgia.—All these forms of neurosis occur very rarely in the larynx, and are, if occurring, usually combined with similar affections in the pharynx. All of them are concomitants of hysteria, hypochondriasis, neurasthenia, anemia, chlorosis, and similar affections, and may be said to pass over into one another without very sharp outlines. The sensations complained of are of a very varying kind; pain, burning, pricking, constriction, dryness, rawness, sensation of a foreign body, pressure, irritation to cough, &c. The result of the laryngoscopic examination in such cases is negative. The treatment of these affections is often very difficult and unsatisfactory. In the first place, attention must be paid to the general health, nervine and tonic remedies be given, sea-bathing or a voyage advised, &c. If the pain be of an intermittent character, quinine should be tried. Locally, applications of astringent remedies or of morphia and chloroform may be instituted; cocaine may prove itself very useful in these cases. Felix Semon.

LARYNX, Scalds of the, not infrequently occur in children from the attempt to drink from the spout of a boiling kettle. A similar effect is produced in adults and children by the swallowing of corrosive fluids, or by the inhalation of the heated vapours from flames or a gas explosion.

There is usually pallor and collapse, followed by restlessness and fever. The patient complains of severe pain about the mouth and fauces. The mucous membrane of these regions is swollen, white, and blistered. Swallowing is painful, and sometimes impossible. The voice is hoarse, or sinks to a whisper. In a short time respiration may be seriously affected from the extension of the swelling to the parts immediately above the rima glottidis, or from reflex contraction of the laryngeal muscles. This dyspnœa is subject to exacerbations, which may prove suddenly fatal. Generally, however, the breathing becomes more hurried, with stridulous inspiration and gradually increasing lividity, until the patient dies in a few hours from exhaustion or asphyxia. Where the injury is less severe, the symptoms may slowly subside, or they may be followed by those of broncho-pneumonia, even in cases in which the laryngeal disturbance has not been so severe as to necessitate tracheotomy.

When death occurs in a few hours, the mucous membrane of the mouth and pharynx, together with that part of the larynx which lies above the true vocal cords, will be found to be sodden, wrinkled, and highly congested, while the œsophagus and the parts below the rima will usually have escaped injury. Should the patient succumb at a later period, the scalded parts will be covered with croupous exudation; partially separated sloughs will be seen about the fauces and epiglottis; the bronchi will be congested and full of viscid mucus or pus; and patches of hepatisation will be dotted over the substance of the lungs.

Treatment.—The child should be placed in a bed surrounded by screens in a warm and steamy atmosphere. Sponges wrung out of hot water should be applied to the front of the neck. Calomel in 1 or 2 grain doses should be given every hour. Antimonial wine, in doses of 1 or 2 minims, with $\frac{1}{4}$ to $\frac{1}{2}$ minim of tincture of aconite, may also be given at first every quarter of an hour, and afterwards at longer intervals. If there should be any persistent dyspnœa, and especially if there should be spasmodic exacerbations, the parts about the fauces and epiglottis should be scarified with some pointed instrument, such as a needle in a handle. This gives exit to the serum of the blisters and to the submucous infiltrations in the upper part of the larynx, and in many cases the operation is followed by great relief. If, however, the symptoms still continue urgent, laryngotomy or tracheotomy should at once be performed. Should broncho-pneumonia supervene at a later period, a linseed-meal poultice should be wrapped round the chest, and expectorants be given, such as ipecacuanha wine with carbonate of ammonia. At first the child should be fed with small quantities of milk and beef-tea, and, if there is much collapse, some brandy must be added. Subsequently a more nourishing diet will be necessary. The treatment of adults will be similar to that of children. Where the patient is vigorous, leeches may be applied to the front of the neck, and, if lung-symptoms should arise, a blister to the upper part of the chest may be beneficial. N. Davies-Colley.

LARYNX, Syphilis of the.—*Causes.* The larynx may be attacked by syphilis in its secondary, tertiary, and congenital forms. The secondary manifestations appear, usually, at the time of the corresponding skin-lesions or a little later; the tertiary symptoms, as a rule, a few years after the primary infection. Both forms, however, are subjected to most striking variations; whilst in some patients a form of superficial ulcerative laryngitis will return year after year, without ever passing into the more serious forms of deep destructive ulceration, on the other hand, lesions belonging to the most severe forms of the tertiary period occasionally appear in the larynx and in the trachea a few months after the primary infection. Again, there may be an outbreak of tertiary syphilis in the larynx five, ten, twenty, even thirty and forty years after the primary infection. The congenital lesions of laryngeal syphilis were considered as excessively rare up to very recent date; lately, however, it has been shown that they are much more common than had been supposed. They usually manifest themselves either shortly after birth, or in the first years of life, or at the time of puberty.

Pathology.—Secondary syphilis of the larynx shows itself usually in the form of a very obstinate catarrh, which has nothing specific in its character, but which is looked upon by some as an erythema. The occurrence of condylomata (mucous patches) is a hotly contested point. If occurring at all, they must be rare and of a very transitory nature. Superficial ulceration, often of a relapsing character, is also met with. The phenomena of tertiary laryngeal syphilis are gummata, deep destructive ulceration, perichondritis of a suppurative or an adhesive character, caries of the cartilages, fibroid thickening and degeneration of the mucous membrane, cicatricial contraction. All these may occur separately or combined, or one following another. Gummata in the larynx are rare. They are generally developed in the submucous tissue, and appear either in the form of multiple, small, sharply defined, often nearly coalescent nodules, or in that of a diffuse infiltration, or as larger, well-defined, smooth nodes. The mucous membrane over them is at first normally coloured, but assumes later on a yellowish tint. They show a great tendency to break down and to change into deep irregular ulcers, which often penetrate very deeply, extend to the perichondrium and the cartilages, and lead to purulent perichondritis, formation of abscesses, fistulous communications with the neighbouring parts, caries, necrosis, and exfoliation of the cartilages. Apart from this form of ulceration, there is another more frequent one, and not preceded by the formation of gummata, which shows a greater tendency to extend in surface than in depth.

Again, there is a form of primary perichondritis in syphilis, in which the mucous membrane is either not at all affected or only secondarily. This perichondritis may either be of an adhesive type, or it may be of a suppurative character, and, in such cases, the mucous membrane only becomes affected at the time when the abscess breaks internally. The further consequences may be, of course, the same as in the cases in which the ulceration extends from the surface to the deeper structures. Often, there is œdema, acute or chronic, in the neighbourhood of the ulcers of both periods and of the gummata; sometimes, fungoid excrescences are found on the borders of the ulcers. These excrescences, which often look like papillomata, are especially seen in the inter-arytænoid fold, a locality in which, as elsewhere stated, genuine non-malignant neoplasms never occur, but in which isolated longitudinal syphilitic ulcers are not rarely found. On the whole, it may be said that syphilitic phenomena may show themselves anywhere in the larynx. The epiglottis, however, is perhaps more frequently attacked than any other part.

Common to all syphilitic ulcerations, whatever their particular form of origin may have been, is the extraordinary tendency to cicatricial contraction on healing and the formation of callous connective tissue. This peculiarity often leads not only to fibroid thickening and to very curious deformities of the individual parts, but also to their coalescence with each other, to the formation of membranous bridges or even of complete diaphragms between the cords or ventricular bands, to adhesion between the epiglottis and the adjacent pharyngeal structures, to extreme stenosis of the laryngeal cavity, &c.

Symptoms.—From a glance at the pathology of the possible changes in laryngeal syphilis, it will be evident that the symptoms may show almost every shade of variation peculiar to the larynx, according to the nature and the gravity of the lesions. Thus, in the secondary affection, with the exception of some hoarseness there are usually no laryngeal symptoms. There may be slight sensations of irritation or of soreness in the throat, but laryngeal syphilis, even in its most serious ulcerating forms, is characterised by complete or nearly complete *absence of pain.* Cough is but rarely present, and hardly ever very troublesome.

In the tertiary stage more definite symptoms are met with. When the vocal cords are either ulcerated or infiltrated by œdema, or fixed in an abnormal position by disease of the crico-arytænoid joints, more or less complete aphonia may be present; when there is stenosis of the larynx, from whatever cause, there will be dyspnœa, often of a dangerous degree; when the epiglottis is partly destroyed by ulceration, and if there be in addition ulceration in the pharynx or œsophagus, there may be some dysphagia, though this rarely forms a very prominent feature.

The laryngoscopical appearances will necessarily vary, almost indefinitely, according to the nature of the lesions in the individual case. The catarrhal congestion of secondary laryngeal syphilis is not very characteristic, and is only distinguished by its obstinacy. Mucous patches are described as smooth yellow projections sometimes 'round, but more often oval, varying in diameter from three to seven millimètres, but in rare cases attaining a breadth of a centimètre' (Mackenzie). The writer has never seen them. The superficial ulceration, which is most frequently intermediate between the secondary and the tertiary changes, is of a decidedly inflammatory character, and often surrounded by a more or less œdematous zone of congestion. The ulcers of the tertiary period show this inflammatory character in even a more decided manner. They are deep, with irregular infiltrated borders and an unhealthy-looking base. Sometimes, when they penetrate to the cartilages and exfoliation of sequestra has taken place, they have an almost crater-like appearance. Gummata have already been described. The congenital lesions of laryngeal syphilis may present themselves in any of the forms under which the acquired disease, in its secondary and tertiary stages, appears.

Diagnosis.—The catarrh of secondary laryngeal syphilis having nothing characteristic in its appearance, the diagnosis of its specific nature will have to be made only from the concomitant existence of undoubted syphilitic affections of the skin, the mucous membranes of the mouth, tongue, pharynx, &c. As stated before, it is distinguished by great obstinacy and resistance to purely anti-catarrhal treatment. It yields, however, quickly to anti-syphilitic measures. On the other hand, it must not be forgotten that a person suffering from secondary syphilis may acquire a common catarrh.

The hoarse voice of children suffering from 'snuffles,' broad condylomata about the anus, &c., will often lead to the inference that the larynx is also attacked, and not rarely laryngoscopic examination will verify the suspicion.

There will not, usually, be much difficulty in rightly interpreting the ulcerative and gummatous manifestations of syphilis. To begin with, in the majority of cases there will be lesions, corresponding to the stage of the constitutional disorder, in other parts of the body, the skin, other mucous membranes, the eyes, bones, abdominal organs, brain, &c., which will at once point to the nature of the laryngeal affection. Even if the latter should occur alone, the patient's history and the discovery of old scars in other parts, notably in the pharynx, will give valuable information. Again, though the laryngeal ulcer of syphilis has nothing absolutely pathognomonic about it, yet there are usually signs sufficient to render it easily distinguishable from tubercular and malignant affections, the only ones—except lupus, which is very rare in the larynx—with which it could be confounded.

The syphilitic ulcer is produced very rapidly—i.e. within a few days; it is evidently of an inflammatory origin, and has an area of more or less active inflammation around it; it is irregular, often large, often deep, usually solitary and unilateral; there are rarely more than two or three ulcers.

The tubercular ulcer, on the other hand, is usually preceded by a long period of pseudo-œdematous infiltration, the parts are usually excessively pale, semi-transparent, the ulcers are very numerous, very small, and only later on confluent; they hardly ever lead to so much destruction as syphilitic ulcers. Moreover, the concomitant pulmonary and constitutional affections will afford valuable diagnostic help. The diagnosis, however, will be sometimes excessively difficult in cases in which phthisis and syphilis are simultaneously present, or in cases in which, besides the laryngeal affection, syphilitic lung-troubles exist. As regards the latter class of cases, it will be useful to remember that syphilitic lung-affections are generally localised, not in the apices but in the middle region of the lungs. Should there be any doubt, it is better to give under all circumstances antisyphilitic remedies.

The scars, thickenings, distortions, webs, &c., left after the healing up of syphilitic ulcers as a rule tell their own tale; occasionally, however, there will be great difficulty in deciding whether immobility of one or both vocal cords is due to previous syphilitic disease and ankylosis of the crico-arytænoid articulations, or to paralysis of the motor laryngeal nerves.

Treatment.—In all syphilitic affections of the larynx, constitutional treatment is of fundamental importance. In the secondary stage, mercurial preparations (hydrargyrum cum cretâ, 1–2 grains, two or three times daily, or a mercurial pill of two grains with opium—gr. $\frac{1}{3}$—twice or three times daily) may be given; or a regular mercurial inunction treatment (half a drachm of mercurial ointment to be used daily) may be instituted. The inhalation of atomised solutions of bichloride of mercury (1 in 500 or in 1,000) has been warmly recommended. Local applications are rarely required. If such be made, solutions of sulphate of copper (15 grains to an ounce of distilled water) or of nitrate of silver (30–60 grains to one ounce of distilled water) may be used.

In the tertiary forms, in which every day unexpected and serious complications may arise, a vigorous iodide of potassium treatment is indicated. It almost always achieves brilliant results, even in cases in which from œdema, or from gummatous infiltration of the larynx and trachea, immediate danger appears to be present. It will, in such apparently hopeless cases, be sometimes possible to avoid scarification and performance of tracheotomy, when they seem to be urgently indicated, if, beginning with the administration of 10-grain doses of iodide of potassium three times daily, one gradually but quickly pushes the dose up to thirty grains three times daily, combining this internal medication with mercurial inunction.

Should there be so much acute œdema of the upper parts of the larynx and such dyspnœa, that the action of internal remedies cannot be waited for, scarification ought to be practised, and if in spite of this the difficulty of breathing continues, tracheotomy must be performed. The latter operation may also be required in cases of subglottic œdema, of chronic stenosis of the air-passages from fibroid thickening of the parts, and in cases of bilateral ankylosis of the arytænoid cartilages in the position of phonation, whereby the glottis is reduced to a narrow slit. In cases of narrowing of the larynx from cicatricial contraction, methodical dilatation by means of Schrötter's hollow vulcanite tubes may be tried; but the writer must confess that he has never been lucky enough, though he has followed this plan very perseveringly in several instances, to either avoid tracheotomy in cases in which this operation appeared to be indicated, or to enable patients, in whom that operation had been performed, and in whom dilatation was practised subsequently, to dispense with the canula. Moreover, the method is not quite free from the risk of setting up active inflammation and even suppurative perichondritis. In cases of cicatricial webs, it may be either attempted to remove them with cutting-forceps, or to divide them by means of Dr. Whistler's cutting-dilator, or to destroy them by means of the galvano-cautery. If the web, however, be very tough, no method can boast of much success, and even removal from without—i.e. after the performance of thyrotomy, with subsequent dilatation, does not protect against a sphincter-like recicatrisation. The patient will, therefore, in such cases most probably have to wear his canula for the rest of his life.

FELIX SEMON.

LARYNX, Tuberculosis of the.—*Causes.*—Laryngeal phthisis is due to the deposit of tubercle in the larynx, and occurs in about 30 per cent. of all cases of pulmonary phthisis. Tubercular disease of the larynx is almost always secondary to the pulmonary affection, though it often occurs at a time when there are no definite physical signs of lung-mischief; quite recently some cases have been put on record, in which the result of the post-mortem examination seems to establish the actual occurrence of primary laryngeal tuberculosis. As regards age and sex, the same conditions obtain as in pulmonary tuberculosis.

Pathology.—The stage of deposit of the tubercle is usually ushered in by infiltration and pseudo-œdematous thickening of the tissues, which is generally most marked in the epiglottis, the arytæno-epiglottidean folds, the mucous membrane covering the arytænoid cartilages, and in the inter-arytænoid fold. This stage is frequently preceded by marked isolated anæmia of the whole mucous membrane of the larynx, especially of the epiglottis. The tubercles themselves are said to have been seen in very rare cases as small greyish or yellowish nodules, but in the great majority of instances they break down so quickly that small ulcers are usually the first signs of their presence. These quickly coalesce, extend in surface and in depth, destroy epithelium and mucous membrane, and lead to perichondritis, caries, necrosis, and exfoliation of parts of the cartilages. In rare cases subepithelial tumours, consisting of an aggregation of miliary tubercles, and cellular infiltration of the mucosa and submucosa, have been found. Even in the stage of extensive ulceration, chronic œdema of the surrounding parts usually persists.

Symptoms.—The most common special symptoms of laryngeal phthisis are cough, with more or less expectoration, hoarseness, aphonia, and dysphagia, all of which may be due to the swollen and ulcerated state of the organ. Cough may, however, also depend upon the concomitant pulmonary affection; aphonia upon implication of the right recurrent nerve in thickening of the pleura of the apex of the right lung, or upon pressure of enlarged bronchial glands upon either or both recurrent laryngeal nerves, leading to paralysis of one or both vocal cords. Cough and dysphagia are generally the most troublesome symptoms of the malady; the latter is often so extreme that it materially hastens the fatal end.

Laryngeal dyspnœa is less common. The shortness of breath on slight exertion, so often observed in these cases, is to be attributed rather to the concomitant lung-affection than to the laryngeal disease. Serious and even fatal laryngeal dyspnœa, with stridulous breathing, may however, occur, either in consequence of extensive œdema, or of impaction of a piece of necrosed cartilage in the glottis, or of mechanical fixation of both vocal cords in the position of phonation. This last may be the result of perichondritis and subsequent ankylosis of the crico-arytænoid joints, or of bilateral paralysis of the glottis-openers, in consequence of implication of both recurrent nerves in lesions of the lungs or of the bronchial glands. *See* LARYNX, Neuroses of the.

Laryngoscopically, the pallor of the tissues is of great diagnostic value. Originating even before the stage of infiltration, it persists throughout the periods of thickening and ulceration. The discovery of such a pallor should always be followed by careful examination of the lungs. In rarer cases there is an obstinate chronic laryngeal catarrh, undistinguishable laryngoscopically, at the beginning, from common laryngitis. With the onset of the tubercular infiltration the appearances often become so pathognomonic, that the diagnosis of phthisis can be made from laryngoscopic inspection alone, though, of course, examination of the lungs, of the sputum for bacilli, &c., must never be neglected. In such cases, the infiltration gives to the eye of the observer the idea of a peculiarly dense, almost semi-solid, pale œdema; one or both of the arytænoid cartilages and arytæno-epiglottidean folds, which are sometimes for some length of time the only parts thus infiltrated, assume a pear-like appearance, the larger end of the pear being represented by the pale, swollen arytænoid cartilages. The epiglottis is often rolled backwards on itself, and looks like a turban. If these pale swollen surfaces are, a little later on, seen studded with small ulcerations, the appearances are almost unmistakable. In other cases the first, and for some time the only, laryngeal symptom is infiltration or ulceration of the inter-arytænoid fold. If, in cases which otherwise warrant suspicion of phthisis, this part be seen to be swollen, velvety-looking, semi-transparent, superficially eroded, or even somewhat ulcerated, this is a sign of evil omen.

The vocal cords and ventricular bands are sometimes, but not often, the parts first affected. They appear sodden, rounded, the cords lose their lustre and become denuded of epithelium; later on, distinct ulcers are visible, their borders appear irregularly eroded, finally they may be partially or wholly destroyed. The superficial ulceration, wherever first seen, soon spreads in depth and extent. Often, the whole laryngeal mucous membrane forms a mass of ulceration covered with thick greenish-yellow secretion. The epiglottis may be, and not rarely is, almost wholly destroyed, or a small stump only is left, and one or both cords may be seen to be immovably fixed in any position, or their movements may be very defective.

Impairment of the mobility of one or both vocal cords may occur at different periods of laryngeal phthisis, and may be due—(*a*) to functional weakness of the (sometimes actually degenerated) laryngeal muscles; (*b*) to extensive infiltration of the tissues, notably of the inter-arytænoid fold, which may mechanically prevent the movements of the cords; (*c*) to actual disease of the crico-arytænoid joints; (*d*) to disease of the afferent motor nerves.

Diagnosis.—The diagnosis of laryngeal tuberculosis presents, as a rule, no great difficulty. In many cases the laryngoscopic examination will suffice; in more doubtful ones, examination of the lungs and of the sputum for bacilli will generally settle the question. In doubtful cases, especially if it be uncertain whether the laryngeal ulceration is syphilitic or tubercular, some of the secretion from the ulcerated surface withdrawn by means of a brush, under guidance of the laryngeal mirror, may be examined for bacilli, and their detection will clinch the diagnosis.

The diseases most likely to be mistaken for laryngeal phthisis are syphilis, carcinoma, chronic œdema, and simple chronic inflammation of the larynx. For the differential diagnosis from syphilis and carcinoma, *see* the articles treating of these affections. Chronic œdema occurs in the course of laryngeal phthisis, as well as in that of the diseases just named. Its greater transparency, and the absence of ulceration on the swollen parts, will usually differentiate it from tubercular infiltration. Whether an obstinate catarrh of the larynx, accompanying pulmonary phthisis, is of a tubercular or a non-tubercular nature, may for some time be doubtful. That non-tubercular catarrhal affections of the larynx may accompany tubercular disease of the lung, has been proven by post-mortem examination. The uselessness of the common treatment of chronic laryngitis, and the occurrence of more definite laryngeal lesions in such cases, may in time lead to a more accurate diagnosis of the true nature of the laryngeal affection.

Treatment.—The constitutional treatment—medical, climatic, hygienic—generally employed in pulmonary phthisis, is to be made use of in laryngeal tuberculosis. As to local medication, there are few diseases in which such a multitude of remedies has been recommended as in laryngeal phthisis. The writer will only mention those which he has found most useful. In the early stage—i.e. before ulceration occurs—he very rarely adopts any local measures. In cases of ulceration he has seen much benefit from the insufflation into the larynx once or twice daily, by means of the powder-blower, under the guidance of the laryngeal mirror, of a powder composed of iodoformi, acidi boracici, ana gr. j., morph. acet. gr. $\frac{1}{6}$–$\frac{1}{2}$, the patient having immediately before cleared the part as much as possible of mucus by coughing. In making the application the mirror must invariably be used, as unless the powder come in contact with the ulcerated surface the treatment is useless. If properly applied, however, the insufflation leads in most cases to diminution of the distressing cough, improvement of the dysphagia, and often to an actual improvement in the condition of the ulcers. In a very few cases, the writer has even seen them disappear for a time under the methodical employment of these insufflations. Quite lately, he has in a few cases of tubercular perichondritis with excessive dysphagia brushed over the whole of the affected parts with a 20 per cent. solution of hydrochlorate of cocaine, to enable the patients to swallow. The effects have been most encouraging. Cocaine may also be used in the form of spray or of pastiles. In cases of advanced œdema, energetic scarification is advised by some authors. Where there is much difficulty in swallowing, the patient's diet ought to consist of liquids thickened by the addition of some arrowroot, cornflour, or isinglass, and drinks ought to be taken at a draught, and not sipped (Mackenzie). In cases of complete aphagia it may become necessary to feed the patient by means of an œsophageal tube.

Tracheotomy ought only be performed when there is direct danger of suffocation from any of the causes enumerated under 'symptoms,' but not otherwise. The experience of the most trustworthy observers shows that when it is performed simply to give the diseased larynx rest, it does not delay the tubercular process, whilst the wearing of the canula enhances the misery of the patient's existence.

Felix Semon.

LATERAL SPINAL CURVATURE.

Scoliosis.—*Definition.*—A lateral deviation and contortion of the spinal column, nearly always accompanied by more or less exaggeration or diminution of the normal antero-posterior curves.

Causes.—Lateral curvature of the spine is predisposed to by weakness of the spinal muscles, combined with long-continued sitting or standing in stooping or careless positions, such as standing on one leg, sitting with the trunk leaning to one side, or with the thighs crossed. Another predisposing cause is inequality in the lengths of the lower extremities, the result of (1) congenital difference in size; (2) atrophy from infantile paralysis; (3) hip-joint disease; (4) congenital dislocation of the hip; (5) unequal muscular power, when one leg is partially paralysed, &c. Eliminating these causes of inequality in the legs, which are common to both sexes, there is no doubt that ordinary lateral curvature, induced by muscular weakness and injurious positions during years of growth and school life, is far more frequent in girls than in boys. This cannot be explained by girls being accustomed to sit in worse positions at school than boys, but by the fact that, as a rule, boys are allowed to correct the evil influence of stooping and lounging over lessons during long school hours, by daily physical exercise, such as cricket, football, &c., whereas girls enjoy far fewer opportunities of exercising their bodies. At the onset of puberty, the development of girls generally throws a greater strain on their health and strength than is the case with boys, and fully developed girls of twelve or fourteen years of age, suffering from lateral spinal curvature, are frequently met with in ordinary practice amongst all classes, but especially amongst the upper and middle.

It is still uncertain why the very large majority of cases of lateral spinal curvature have the upper or dorsal curve with the convexity to the right. Dismissing theories about the supposed influence of the arch of the aorta, it is very probable that the greater use of the right arm and hand is a predisposing cause; although, at the same time it must be admitted, that cases with the convexity of the upper or dorsal lateral curvature to the left are not at all limited to left-handed patients.

Weakness of the muscles is always accompanied by a corresponding weakness or softness of the bones to which they are attached. There is, besides, often an hereditary predisposition to lateral curvature, due either to inherited excessive softness of the bones, or weakness of the muscles, or to both combined. The writer knows of many cases where a mother and her daughters had more or less severe lateral curvature, and he has watched a family where father, daughter, and granddaughter by a son, had all marked lateral curvature, the father being much deformed.

Rickets is frequently associated with lateral curvature, and some of the worst deformities seen in museums are of this class, the curvature being induced either by unequal shortening of the legs from deformity, or by the excessive softness of the bones, or by these causes in combination, aided by the usual factor of weak muscles. As a general rule, anything which weakens the muscular system tends to produce lateral curvature, which often therefore follows convalescence from one of the acute zymotic diseases or a severe inflammation of the lungs. Too rapid a growth, or the too rapid laying on of fat at the time of puberty, is a frequent cause; the writer has observed that a large proportion of patients with lateral curvature are either too tall or too short, the latter condition occurring as the result of illness, which has not only weakened the muscles but also retarded a normal state of growth.

So far, ordinary lateral curvature only has been considered, but unilateral affections of the thoracic viscera, such as severe empyema in a stage of recovery with dragging down of the thoracic walls, or severe adhesions the result of old pleurisy, will also produce lateral curvature with concavity on the same side as the chest affection; in such cases, torsion of the lateral curvature is generally absent for a time.

Pathology.—Innumerable works have been written on the pathology of lateral curvature, and the most diverse views propounded as to whether it is caused by the weakness of the bones, ligaments, or muscles. Simple lateral curvature is hardly ever met with, except in cases due to empyema or severe disease of one lung. In the large majority of cases, the lateral curvature of the spine is accompanied by a rotation, on their axes, of the bodies of the vertebræ implicated in the given curvature, so that the transverse processes of the same side as the convexity of the curvature are directed backwards, while the transverse processes of the other side of the vertebral bodies, viz., towards the concavity of the curvature, are of necessity directed forwards. For example, in the common form of lateral curvature with dorsal or upper convexity to the right, and lumbar or lower convexity to the left, the right transverse processes of the dorsal vertebræ and the ribs attached to them are directed backwards. This torsion of the bodies of the vertebræ is probably caused by the muscles of the spine and trunk trying to recover the vertical position of the spine, and, failing in this, tending to partly restore equilibrium by twisting the portion of the trunk immediately above the convexity of the curvature, round to the same side.

It is difficult to say precisely whether the dorsal or lumbar lateral curvature is first established. No doubt as soon as one curvature is confirmed, a compensating curvature to the opposite side forms, and, in most cases, the head is flexed to the same side as the convexity of the dorsal curvature (cervical convexity to the left). In many cases when seen in the earliest stage, with scarcely any or no permanent osseous deformity, a distinct dorsal curvature with convexity to the right and a lumbar curvature with convexity to the left will be found, where it is but fair to conclude that the two curves began simultaneously. It is an important fact, that when once there is actual osseous deformity of the ribs and vertebræ, to that extent lateral curvature is incurable. Before a patient can become the subject of moderate or severe osseous lateral curvature, she must have passed through many intermediate stages from the first onset of the deformity, when she began to sit or stand with the spine slightly flexed to one side. At that time, if an anatomical examination could have been made, only some flabbiness or want of development of the muscles would have been found. As the curvature creeps insidiously on, the bodies of the vertebræ become gradually misshapen, so that they are more or less wedge-shaped transversely to the longitudinal axis of the spine, i.e. the vertical depth of a vertebral body will be one or more lines greater on the side corresponding to the convexity of a pathological curvature as compared with the side facing the concavity. The intervertebral fibro-cartilages also become wedge-shaped to the same or even to a greater degree. It is to be noted that the amount of lateral curvature observed by looking at the tips of the posterior spinous processes under the skin, always implies a much greater amount of actual lateral curvature of the bodies of the vertebræ. This can be easily understood by bearing in mind the rotation, on their axes, of the vertebral bodies during the formation of the lateral curvature, which tends to make the posterior spinous processes lie more and more in an imaginary vertical line, drawn through the arcs of the upper and lower lateral curves.

Lateral curvature may accompany spinal caries, or may directly result from caries of one lateral half of one or more vertebræ, but such cases are very exceptional. So also lateral curvature of congenital origin, the result of extra-lateral halves of vertebral bodies being inserted between the normal vertebræ, is extremely rare; according to Neugebauer, only thirteen such pathological specimens are on record. The osseous tissue of the spinal column, even in the severest cases of non-rickety deformity, generally appears to be quite normal; the chief pathological change, in addition to the actual deformation of the vertebræ, intervertebral cartilages, and ribs, is the frequent presence, in severe cases, of buttresses of new osseous deposits within the concavity of each lateral curvature, as a compensation for the instability caused by the deviation from the vertical line. The descending aorta, and other soft tissues, follow the severest undulating curvatures of the spine. In lateral curvature with much osseous deformity, the ribs opposite the convexity of the dorsal curvature become extremely convex posteriorly, and so flattened anteriorly that the sternal and vertebral ends of the same rib become almost or quite parallel. The corresponding ribs opposite the concavity become much flattened behind and too convex in front, causing undue prominence, and at times pseudo-enlargement, of the mamma of that side. Adjacent ribs are sometimes welded together by osseous tissue in cases of extreme deformity.

Symptoms.—Cases of lateral curvature may be divided, clinically, into two great classes: (1) where pain in the back is the first symptom observed, and (2) where some deformity, as the undue prominence of a shoulder-blade, or of an iliac crest, or general stooping, first directs attention to the presence of lateral curvature. It may be stated generally that the amount of pain complained of is seldom in proportion to the amount of deformity. Cases of extreme lateral curvature are frequently seen, where there is not and never has been any pain felt by the patient, although the health may have been affected in other ways, by indigestion, headache, shortness of breath, &c. On the other hand, life may have become almost unbearable on account of constant backache, and the symptoms almost assume those of so-called 'spinal irritation,' in cases where the curvature is but slight.

Ordinary case of Lateral Curvature.—To take an average case of the ordinary type, that is, one not due to inequality of the lower extremities or paralysis. A school-girl of fifteen has stooped more or less for several years, especially during the last three; has complained of weakness and pain in the back for two years past, which became worse after measles, one and a half years ago. Her general health has always been good. She is a short, stoutish girl, with awkward gait, anæmic; complains of pain in the lower dorsal and lumbar regions whenever she has been sitting for an hour or so; generally has pain every evening before going to bed; half an hour's walk brings on the same pain. During the last three years at school the patient has written at a flat table, sitting on a bench without a back, with the trunk in an oblique position.

Mode of Examination.—Both boots should be taken off, and the clothes covering the trunk removed, a petticoat being fastened round the pelvis, well below the crista ilii, and sufficiently low to leave the upper end of the gluteal cleft visible; the latter is especially important in stout adult patients, as a guide to the middle line. The patient stands exactly in front of the surgeon with the back to him, the feet together and symmetrically placed, and the knees kept fully extended. The gluteal cleft is placed exactly in the middle line as compared with the feet and legs; in this way, any rotation of the pelvis, on its transverse axis, is corrected. With these exceptions, the patient is to stand in her habitual or most comfortable position.

In the case taken, there is decided irregularity in the lateral outlines of the trunk, the right side being too much hollowed, with undue prominence of the right iliac crest, while the left iliac crest is not visible as a prominence at all. The lower angle of the right scapula is rather higher and more prominent than that of the left. The posterior spinous process of each vertebra, beginning at the seventh cervical, and ending at the top of the sacrum, should now be carefully marked, and for this purpose one of the popular copying pencils, such as the soft 'automatic eagle,' is best, as the perspiration of the patient's skin facilitates the marking. Any special tenderness of one or more vertebræ will be at once recognised during the marking. This local hyperæsthesia is often present in lateral curvature, and does not indicate spinal caries in any way. The dorsal or upper lateral curvature with convexity to the right, and lower or lumbar lateral curvature with convexity to the left, are much more readily recognised after the marking. The right side, below the scapula, is decidedly fuller than the left. It should be noticed whether the two iliac crests are really on the same level, and this is done by the surgeon carefully and firmly pressing a forefinger of each hand into the soft tissues above each iliac bone; any apparent difference in level will disappear at once if the lower limbs are of equal length.

In the common form of lateral curvature, with dorsal convexity to the right, and lumbar convexity to the left, the *right* iliac crest is generally too prominent, as just stated. This increased prominence of the right iliac crest is produced by the lumbar lateral curvature carrying the trunk, immediately above the sacrum, at first to the left till the centre of the convexity is reached. The soft tissues, above the right iliac crest, are thus carried over towards the left, and if there is much subcutaneous fat, this often makes the right iliac crest appear too high, as if the pelvis were tilted transversely. The prominence of the left iliac crest at the same time becomes less than usual, or is lost altogether, because the skin, fat, &c., are carried more over it than usual. Sometimes, however, the *left* iliac crest appears too prominent, even in cases of ordinary lateral curvature with dorsal convexity to the right, when the dorsal curvature implicates a larger number of vertebræ than usual, while the lumbar lateral curvature is but slight. In these cases, the lower half of the dorsal curvature carries the whole trunk over to the right, leaving the left iliac crest uncovered, and hence apparently too high.

If there is any doubt about the lengths of the legs being equal, accurate measurements must be taken before the conclusion of the examination. Allowing the petticoats to slip below the gluteal folds will often settle the point; for if the buttocks are perfectly symmetrical, there cannot be much, if any, difference. A practical method of ascertaining this at once, and one which does not entail any further undressing than the baring of the knees, is to make the patient lie on the ground, perfectly straight on her back, with the hips and knees fully flexed, and the feet placed symmetrically close together on the ground, with the knees touching each other. The slightest difference in length, of the two lower extremities, will be indicated either by a higher level or by a greater projection forwards of one knee. If such difference be present, the ordinary measurements, between the antero-superior iliac spinous process and the internal malleolus are to be taken, to obtain the actual amount of shortening.

To return to the examination of the trunk; the patient, still in her natural or habitual position, but with the knees straight and the feet close together, is now looked at *sideways*; a considerable exaggeration of the usual cervico-dorsal antero-posterior curve is generally observed; the middle dorsal vertebræ may, in some cases, have their posterior spinous processes projecting backwards beyond the vertical plane of the sacrum. At the same time the abdomen is too prominent, even when the patient is emaciated, and the thorax anteriorly is flattened, frequently with much hollowing of the infra-mammary regions. The head pokes, and the neck is directed forwards in front of, instead of being at the top of, the trunk. The patient should now be inspected *anteriorly* in the same position as before; generally the two lateral halves of the trunk appear more unsymmetrical than from behind; the mammæ, if at all developed, will exaggerate any deformity of the surfaces on which they lie. In the usual form of lateral curvature, with upper dorsal convexity to the right, the left mamma is generally more prominent, and considerably lower than the right; this undue prominence of the left mamma is due to the greater convexity of the left ribs anteriorly. The right iliac crest will also appear more prominent than when seen from behind.

The patient should now be again examined from behind, and, while the knees are kept well extended, requested to flex the trunk fully forwards, the arms hanging loosely downwards. In the case described, the left erector spinæ muscle, between the iliac crest and the last rib, is considerably broader and more prominent as compared with the corresponding right muscle, which was unduly depressed; the lumbar lateral curve being convex to the left, the left transverse processes of the lumbar vertebræ have been rotated backwards, raising up the large mass of the erector spinæ muscle, while the right transverse processes are rotated forwards, causing the overlying muscle to be less prominent than usual. In this flexed position of the trunk, the ribs posteriorly are left uncovered by the elevation and falling forwards of the scapulæ; the right ribs have their posterior angles and adjacent portions too convex, and on a higher level than the corresponding left ribs. This is due to exactly the same cause as the want of symmetry of the erectores spinæ muscles; the dorsal curvature being convex to the right, the right transverse processes of the dorsal vertebræ, with the ribs attached, have been rotated backwards, while the left transverse processes and corresponding ribs have been rotated forwards. The whole prognosis, as will be seen later, depends upon the greater or lesser want of symmetry of the two lateral halves of the trunk, examined thus while the spine is flexed.

To obtain an accurate record, for future reference, of the want of symmetry of the patient's back, the writer employs a malleable strip of lead applied *transversely* to the ribs posteriorly, and extending from the lower angle of the right scapula to the corresponding portion of the left scapula, while the patient's spine is well flexed with the arms hanging feebly down; from this a tracing can be readily taken on a sheet of paper. Another transverse tracing can then be made of the loins opposite the third lumbar spine, and extending on each side to where the muscular walls of the abdomen commence. In each tracing the position of the spine should be carefully marked.

The patient should next be directed to place herself in what she considers the most erect position; if there is any curvature, she will only aggravate the deformity by throwing the trunk too far backwards, by unequally raising the scapulæ, and putting the head to one side, or by assuming some equally unnatural position. The surgeon should now place the patient in the *best possible position*; in slight cases, where there is very little or no osseous deformity, he will succeed in obtaining a perfectly normal posture with the scapulæ and iliac crests symmetrical, the thorax well thrown out, the abdomen withdrawn from undue prominence, and the head erect. The patient should be observed in this improved position, not only posteriorly, but also laterally and anteriorly. The patient is only able to maintain this position by a great effort for a few seconds, and she will feel as if she were more crooked than before. The muscular sense has become so perverted, that the habitual crooked position appears to her to be far more natural and straighter than the really erect or improved posture; the latter gives her, at first, the impression of an exaggeration of the deformity. In severer cases, it is necessary to ascertain the position of the arms which gives the best average improvement of the whole spine and trunk, e.g. the right arm directed upwards, the left outwards at right angles to the trunk, is a position which, in a large number of cases, effects this improvement, and to this the writer refers as the '*key-note*' position while describing the treatment. It is advisable, before concluding the examination, to let the patient stand erect with her back against the door, heels, sacrum, dorsum and occiput touching it, and with the shoulders well thrown back. While in this position, her mother or friend should try to fasten the stays and clothes in front. In most cases these will not meet for one or more inches, such great alteration and enlargement of the thorax anteriorly being effected by this simple device. This applies not only to females, but also to males, the waistcoat, coat, and overcoat, and frequently even the shirt collar, not meeting for an inch or more when the patient is placed thus with his back against the door. Finally, the stockings being removed, notice should be taken whether the patient is flat-footed or not. One out of every three cases of lateral spinal curvature has marked flat-foot (*see* FLAT-FOOT).

The *prognosis* depends altogether on the presence or absence of permanent osseous deformity of the ribs and vertebral column. If there is no osseous deformity found when the patient's trunk is flexed, it is possible in all cases to restore the patient's figure to the normal, and to prognosticate a more or less complete cure; the only exception being where the curvature is due to paralysis of the spinal muscles, when the prognosis is doubtful and difficult. Again, patients with deficient intellect, or who take no interest in their treatment, are difficult to benefit, and the prognosis is unfavourable.

Any case of 'confirmed' lateral curvature, i.e. where the patient has lost the muscular sense of a really straight position of the spine, and where his unaided attempts to rectify the deformity only tend instead to increase it, if left untreated is bound to become worse during a series of either months or years; some cases become much more rapidly worse than others. The popular and prevalent opinion that 'the patient will grow out of it in time,' without any special treatment being employed, is to be combated; cases of lateral curvature of the spine, which might have been thoroughly cured when first observed, are hence often neglected till too late, when a cure, i.e. complete restoration of form as well as of function, is out of the question.

Lateral curvature without any osseous deformity can, generally, be practically cured by one month's daily treatment; but strict attention to position, and perseverance with prescribed exercises for about a year afterwards, are needful to prevent relapse.

Where there is more or less permanent osseous deformity, the amount of improvement possible can be roughly judged of at the first examination. As a rule, the patient can be sufficiently strengthened, and the muscular sense thoroughly re-educated so that the best possible position becomes an habitual one, by three months' daily treatment.

The presence of much *pain* may sometimes prolong the time required; but, even in these cases, one month's daily treatment generally effects a decided improvement, with more or less relief to the pain; and three months' a complete disappearance of the pain, and a greatly improved figure, i.e. the best possible habitual posture which the osseous deformity admits of.

In cases of extreme osseous deformity, the steel or other spinal support, if worn even for years, should be discontinued at once; and if the treatment advised below is followed, complete, or almost complete, relief from pain, and a greater or less improvement in the figure and straightness of the spine will be obtained in three months; but the actual osseous deformity of the ribs and vertebræ cannot be much, if at all, altered.

Treatment.—Common sense suggests that any inequality, in the potential or actual lengths of the lower extremities, is to be corrected by wearing a thicker sole on the shorter leg, whatever other treatment may appear to be indicated.

Of late years, the implicit faith formerly placed in the treatment of lateral curvature of the spine by steel and other supports has been gradually undermined, and even those who still adhere to the mechanical treatment of spinal deformities not due to caries, attach more and more importance to its association with suitably prescribed gymnastics. Lateral spinal curvatures, due to paralysis of the erectores spinæ muscles, when the patient is unable, by a voluntary effort, to maintain himself in an improved position, are the only cases in which spinal supports are of any real benefit. In these paralysed backs, it is necessary to prevent further increase of deformity by wearing some sort of spinal support, either the ordinary steel one with pelvic band and uprights, with or without crutches to fit into the axillæ; or, which is far better, a well-applied Sayre's plaster-jacket, which should be worn till the muscles have sufficiently recovered from their paralysis to enable the patient to hold the spine in an improved position. It is understood that the support is worn with the sole idea of being preventive, and not of being curative, and should be left off at night in bed.

Lying on the back for several hours daily, still frequently prescribed, is perfectly useless, as far as cure is concerned. If a limb with weak muscles were put into splints, and kept at rest for several hours daily, the muscles would surely become still weaker; and this is equally true of the spinal muscles. The patient may rest prone or supine for fifteen or thirty minutes at a time, for the relief of pain or when fatigued by exercise, but lying for longer periods does more harm than good.

The *treatment* advocated by the writer is based upon the following principles, and may be taken under the following heads:—

(*a*) Re-education of the patient's muscular sense as to an erect or improved position.

(*b*) Improved position to be maintained at all times, while sitting or standing.

(*c*) Attention to dress.

(*d*) Systematic training of the spinal and other muscles, including the development of the thorax.

(*e*) Attention to general health.

a. Re-education of the patient's muscular sense as to an erect or improved position.—A patient, with confirmed lateral spinal curvature, is so habituated to the crooked position, that considerable patience and perseverance are required to convince him or her that an erect or improved posture is really such, and not an exaggeration of the deformity. The best way of commencing this re-education is for the patient to lie on the back in the best possible position, and then to practise slow breathing, the shoulders being kept well pressed back, and prevented from rising by the patient trying to push the hands down towards the feet as much as possible. All the simple movements of the head (neck), arms, and legs can be practised in this position. A hand looking-glass, as well as an ordinary wall-mirror, is required, so that the patient may see and be convinced of the improved position.

As a home prescription, it is useful to direct the patient to stand frequently (e.g. before and after each meal), in front of a looking-glass, with the eyes closed until she believes she has placed herself in an erect position; generally, on first attempting this experiment, she opens her eyes to find that the head is inclined to one side or one shoulder unduly raised. Usually by the end of a week, and, in very persevering and intelligent patients, even at the end of two or three days, the muscular sense is sufficiently improved to enable the patient to place herself at once in a decidedly improved posture by a voluntary effort at any moment, whether lying, sitting, standing, or walking.

b. Improved position to be maintained at all times, while sitting or standing.—This best possible posture is always to be maintained while sitting, whatever the occupation of the moment may be, at meals, at the piano, while reading, writing, &c. It is most readily obtained by sitting with the sacrum, loins, dorsum, and shoulders well supported against the back of the chair, which should be moulded to the normal shape of the spine, with a slight prominence to fill the lumbar hollow. Almost any ordinary chair can be made to answer the purpose, if a suitable cushion is used. In writing, the patient's trunk is required to be more vertical than for reading, and it is essential that not only the trunk but the arms should remain perfectly symmetrical. A sloping desk is absolutely required, and the paper should be oblique, sloping upwards from right to left, but exactly in front of the patient. The Glendinning adjustable modern school-desk and seat, manufactured by the North of England School Furnishing Company, Darlington, will be found most beneficial for patients of school age, and even for adults. In reading, an inclined back to the chair is more restful to the patient, and an easel-table should support the book. For music the same rules apply, the ordinary music-stool being discarded and a high-backed chair employed, which will also come in useful for meals. In all cases, the seat of the chair or couch should be horizontal, and not tilted up in front, as is frequently seen in so-called spinal couches, and the patients feet should always be supported either by the ground or by a footstool. The thighs should never be crossed, as this throws the spine as much on one side as standing on one leg does.

Short-sight, or any other deficiency of the eyes, must be at once attended to, by suitable spectacles, &c., as it would be useless to urge a patient to hold himself erect who had always to poke the head forward for reading or looking at any object.

The patient may walk, run, and join in games, even lawn-tennis, if sufficiently strong, provided any fatigue thus induced disappears after resting for a quarter or half an hour; any walk or exercise that induces fatigue or pain lasting hours, only does harm. In such cases the duration of the walk, &c., must be curtailed. Standing still should be avoided at all times; when inevitable, the patient should stand equally on both legs, with the feet slightly apart. Standing on one leg is most injurious, as it at once throws the spine into a serpentine position, increasing the lateral curvature.

A horsehair mattress with a low pillow for the head, is all that can be advised for the night.

c. Attention to Dress.—It is essential that no article of clothing should interfere with the resumption of an improved or perfectly normal position of the patients' spine and trunk. This can be tested by making the patient stand with the back to the wall and with the clothes opened in front, as already mentioned (see *Mode of Examination*). In women, there should be no red zone of pressure on the skin of the thorax or abdomen produced by stays or injudiciously placed petticoat-bands; the latter should be shaped and made to fit round the pelvis, so as not to compress the lower ribs above the iliac crests. Stays with very little whalebone or steel, and with a vertical slip of elastic webbing, expanding transversely, inserted on each side, are strongly advised. Such stays admit of the full expansion of the lower ribs.

d. Systematic training of the spinal and other muscles, including the development of the thorax.—At first, attention is to be directed to correcting the antero-posterior curves of the spine; when these are improved, then only is it possible to carry out special exercises for correcting the dorsal and lumbar lateral curves.

The following is a prescription of twelve exercises which are recommended to be used at the commencement of the treatment of all cases of lateral curvature of the spine. The patient should rest for a minute or two between each exercise, on a couch with movable back fixed at an angle of 45°, or an ordinary chair if properly arranged.

First prescription of exercises.

1. Lying on back, arms by the sides of the body, hands supinated, slow full inspiration by the nose; slow expiration by the mouth (repeated four times).

2. Similar exercise with the arms extended upwards by the sides of the head (repeat four times).

3. Same position as 1, head-rotation on axis to right and left alternately; also lateral flexion of head to right and left alternately (four times).

4. Lying on back, slow simultaneous circumduction of both shoulder-joints from before backwards, elbows and wrists extended (twelve times).

5. Same position as 1; hip-circumduction both ways slowly; knees kept extended (ten times).

6. Lying on back, simultaneous extension of arms upwards, outwards, and downwards from a position with the elbows flexed and close to the trunk (four times).

7. Lying prone; hip-circumduction both ways; knee kept extended (ten times).

8. Sitting on couch with back at an angle of 45°: ankle-circumduction down, in, up, out, the toes being directed inwards the whole time (twenty times); also foot adduction (patient resisting); abduction (surgeon resisting), (eight times). [This may be omitted if there is no tendency to flat-foot.]

9. Lying on back, arms extended upwards by the sides of the head; slow flexion of both arms (surgeon resisting by grasping the hands), followed by extension (patient resisting), (six to eight times). The patient's knees, flexed over the end of the couch or table, fix the trunk.

10. Patient sitting astride a narrow table or chair without back, with arms down and hands supinated, trunk-flexion at the lumbar vertebræ (patient resisting slightly), followed by trunk-extension (surgeon resisting by his hand against back of patient's head), (six to ten times).

11. Patient with arms extended upwards, leans against a vertical post or door fitted with pegs on each side, which he grasps; the surgeon gently pulls the patient's pelvis forwards by his hands on the

sacrum (patient resisting), and the patient then moves back the pelvis to the post or door (surgeon resisting), (six to eight times). At no time are the patient's heels to be raised from the floor. Also pelvis-rotation on its axis to right and left alternately (surgeon resisting with his hands on each side of the pelvis), (six to eight times).

12. Lying on back with head and neck projecting beyond the end of the table, arms by the sides of the body, hands supinated; the head is gently flexed by the surgeon's hand on the occiput (patient resisting), followed by head-extension (surgeon resisting), (eight times).

It is important, while doing these exercises, that respiration should not be interfered with by involuntary fixation of the walls of the thorax. The patient should therefore always go on counting aloud (e.g. 1 to 10) during the execution of all exercises except those of respiration. From six to twelve longitudinal 'strokings' from above down of the patient's back by the assistant's palms, generally remove any aching caused by the exercises. These strokings are also usefully employed at home to relieve back-ache. All the exercises should be done slowly, and great care taken that the head and trunk remain the whole time in the best position. The above twelve exercises require about an hour's time, and should be followed by a short rest in a good position, with the back supported. In ordinary general practice, an intelligent mother or nurse can be readily trained to superintend all the simple movements.

These exercises are repeated daily, and as the patient gradually gains more power, and begins to assume the improved position more readily and with less exertion, other more severe exercises may be prescribed. In a few days, if there is no increase of back-ache, the following *standing* exercise is done; the patient, with the feet slightly apart and the heels fixed against a ledge or wall, rests with the front of the thighs against a low padded horizontal bar, while holding herself as erect as possible; the surgeon then gently flexes the patient's trunk by pressing his hand against the back of her head (patient resisting), and then the patient slowly recovers the vertical position against the surgeon's resistance, this being in fact exercise 10, in a standing instead of a sitting posture.

In about three weeks or a month, the following much more severe exercise can be tried, known as '*Forwards lying, heels fixed, trunk extension and flexion.*' This is done as follows:—the patient lies prone, with the pelvis and legs supported, and the heels fixed (the latter best by someone sitting on them), on a padded table, while the head and trunk to the level of the iliac crests project beyond the edge of the table. The patient slowly raises the trunk into the same horizontal position as the legs and pelvis, and slightly higher, and then as slowly allows the trunk to be again flexed by its own weight. The surgeon easily increases the severity of the exercise, if required, by more or less pressure with one hand at the back of the patient's head. During this exercise, the arms may be in any position required. By the time the patient is able to perform this exercise without pain, the antero-posterior curves will be sufficiently improved, and more attention can be paid to her being exercised in the 'key-note' position, i.e. that position of the trunk and arms in which the greatest improvement in the position of the spine is obtained. (See *Mode of Examination.*)

Another good exercise is one shortly described as '*Long sitting, trunk extension and flexion.*' Here the patient sits on a table, with the legs together and the knees extended; an assistant sits on the tibiæ, just above the feet, to fix the legs, and the patient slowly extends the spine against the surgeon's resistance (applied by his hand against the back of the patient's head) till the trunk is in the same horizontal plane as the legs; the patient then gently resists, while the surgeon slowly raises her trunk into a vertical position.

Female patients continue the daily repetition of these exercises during the menses, except that the hip-circumductions are omitted for three or four days, as these movements tend to increase the menstrual flow. Where menorrhagia or dysmenorrhœa is present, it is sometimes necessary to leave off the exercises altogether for a day or two. As a general rule, it is better to accustom the patient to practise the exercises all through the period of menstruation. While on the subject, it may be stated that flexions of the uterus are no hindrance to the treatment, as none of the exercises described are violent or jerky in their execution, and from the fact that respiration is never allowed to be impeded by the previously mentioned simple device of making the patient constantly count aloud, any over-exertion can always be prevented with ordinary care.

The patient's spine should be examined every fortnight or month in order to observe how it is affected by the treatment, and whether any alteration of details is required. As already mentioned, one month's daily perseverance in the treatment will effect a very decided improvement in all cases, except those due to paralysis; some with no osseous deformity will even be quite cured, and others at the end of two months. To keep up the improvement, or to prevent any relapse in a cured case, it is very important to enlist the patient's co-operation and interest in her own case on ceasing treatment, and for some months she should continue the habit of practising the movements already described.

Bernard Roth.

LEECH, Artificial, an ingenious contrivance, obtainable at any surgical instrument maker's, consisting of two parts—1st, *the knife*, arranged in the form of a small rotating trephine, with a cutting edge which projects from a flat surface and can be adjusted at any depth thought sufficient to cut through the *cutis vera* only; 2nd, *the sucker*, a hollow glass cylinder, about three-quarters of an inch in diameter, fitted with a piston worked by a fine screw.

The part having been sponged with warm water, an incision is made with the knife, the open end of the sucker placed firmly over the wound, and the blood extracted by slowly withdrawing the piston. Two or three drachms can readily be taken by this process, which is, in fact, merely a modification of wet cupping. *See* Cupping.

The method is of use when a leech is objected to by an over-sensitive patient, and is particularly suited for application to the temple or behind the ear.

William H. Bennett.

LEECHES.—Leeching is a convenient method of *local blood-letting*, in which an approximate idea of the amount of blood taken can be formed. It is applicable to any part of the external surface of the body (with the exception of the eyelids), and to any mucous cavity which is freely accessible from without, such as the mouth, the vagina, and the margins of the os uteri. Leeches should not be applied to acutely inflamed skin, to the anus if extensive piles exist, nor immediately over varicose veins. An ordinary fresh leech will abstract about f℥ij. of blood, which may be increased by about half by fomenting or poulticing the bite.

Leeches should be taken from the water in which they have been kept, and dried on a soft towel, about half an hour before use. It is desirable that a leech should be used once only.

Method of Application.—When the external surface of the body is to be operated on, the part should, if necessary, be shaved and then sponged with warm water, or, what is better, rubbed over with milk. If a single leech is to be applied, it may be taken between the finger and thumb and held with its *small end* in contact with the part until it attaches itself. A preferable plan, however, especially if it is necessary that the bite should be exactly localised, is to place the leech in a leech-glass or roll of cardboard, either of which may be made to accurately determine the point of fixation. If more than one is to be used, the simplest plan is to place two, three, or more leeches in a large pill-box or small teacup, which is then inverted and held on the part; other devices of a similar kind may suggest themselves—e.g. a folded handkerchief, a cone of cardboard, or a nest of cotton-wool.

The application of a leech inside a cavity should be effected by means of a 'leech-glass,' the part having been exposed to view as freely as possible; for instance, in the case of the os uteri, a vaginal speculum should be passed and retained *in situ* until the leech has relaxed its hold. In leeching the immediate vicinity of the orifice of any canal, it is a wise precaution to plug the opening, when possible, with cotton-wool.

In the event of an obstinate refusal to bite, a drop of blood drawn by the prick of a needle will afford an irresistible bait. When fully distended, the leech usually relaxes its hold and falls off; if it does not, a little salt sprinkled over it will effect the separation. The bleeding from the bites as a rule ceases upon exposure to the air, or can be stopped by the pressure of a finger or pad of lint; should it persist, a drop of perchloride of iron or the touch of a red-hot needle is sufficient, excepting in very rare cases, when it may be necessary to encircle the bite with a ligature tied beneath a needle, which has been passed under its base.

In delicate persons, in whom a leech often creates great disgust, if one only is necessary, an efficient substitute will be found in the artificial leech, *see* Leech, Artificial. The scar of a leech-bite, although small, is indelible.

William H. Bennett.

LEG, Amputations of the, are performed in its lower, middle, and upper thirds by the following methods :—

In the Lower Third by (*a*) the circular method; (*b*) modified circular (Syme, Liston, Lenoir); (*c*) long anterior flap (Bell, Teale); (*d*) elliptic posterior flap (Guyon).

In the Middle Third by (*a*) long anterior curved flap (Bell); (*b*) Hey's amputation by short anterior and long posterior flap; (*c*) rectangular (Teale); (*d*) long posterior rectangular (Lee); (*e*) single posterior flap.

In the Upper Third at 'the place of election,' a hand's breadth below the lower edge of the patella, by (*a*) the circular method; (*b*) short anterior and long posterior flaps (Liston, Syme, Skey); (*c*) unilateral external flap (Sedillot, Guérin); (*d*) rectangular (Teale); (*e*) modifications of rectangular (Wharton, Lee); (*f*) antero-external and postero-internal semilunar flaps (Bell); and (*g*) *above* the place of election, the circular amputation (Larrey), in which the tibia is divided through, but not above the tubercle, and the head of the fibula disarticulated. The alleged advantages of this last procedure are, its being easier than at the 'place of election' from the absence of an interosseous space, and only a single artery—the popliteal—requiring deligation; but the frequency of communication between the superior tibio-fibular articulation and the knee-joint is sufficient to render the operation one attended with considerable risk.

The situation best adapted to the *circular* method and its modifications is the lower third, in which, owing to the large number of tendons, the 'flap' methods are not as a rule indicated. In performing the circular amputation immediately above the ankle, difficulty, consequent on the increasing size of the limb, is sometimes experienced, in reflecting the flaps, and hence the modifications recommended by Lenoir and Syme. The former made, in addition to the circular, a vertical incision about an inch and a half in length, corresponding to the crest of the tibia, and dissected back the skin-flaps right and left. Syme, with the same object, made two lunated incisions, one anterior and the other posterior; but, at the 'place of election' and immediately above it, the circular method can be carried out without these modifications.

In the lower third some authorities consider Teale's *rectangular flap* operation to be indicated; but having regard to the thinness of the anterior flap, there is, in the writer's opinion, a danger of sloughing, although, doubtless, the risk is diminished by taking care to include the anterior tibial artery in the flap. To avoid wounding this vessel, it is recommended that the handle of the scalpel should be used in raising the vessels from the interosseous membrane; and, in operating high up in the leg, the surgeon must be careful not to cut the origin of the anterior tibial artery when dissecting the short flap. Half the circumference of the limb at the point where the bone is divided will be the length and the breadth of the anterior flap; the breadth of the posterior flap will be the same as that of the anterior, and its length one-fourth of that flap. Having divided the integumentary structures at the outset, to allow for contraction, the deeper incisions are made, following closely the line of the contracted integument, and the danger of muscular protrusion is in this way avoided. To obviate the risk already mentioned—namely of sloughing —care must be observed in dissecting up the anterior flap to include the anterior tibial artery. The posterior flap is formed by a circular sweep of the knife, and is dissected back to a point corresponding to the situation of the osseous section. The rest of the operation is performed as already described. The inferior angles of both flaps should first be united, and then their remaining edges brought into accurate apposition with numerous points of interrupted suture. The advantages of this method are that the cicatrix is drawn well behind the point of pressure, the wound is dependent, so that in the event of matter forming, it gravitates through it; the principal vessels and nerves in the posterior flap are removed from pressure, the flap affords ample covering for the bones, and the risk of conical or sugar-loaf stump is greatly diminished.

The other *flap* operations are done at the place of election and at the middle third. For amputation at the middle of the leg Hey's method, which has not, in the writer's opinion, received sufficient recognition, is, of the 'flap' methods, decidedly the best. It consists in obtaining a short but broad anterior flap and a long posterior one. The circumference of the limb being taken, two-thirds of it will be the breadth, and one inch the length of the anterior flap, while one-third will be the breadth and one-third the length of the posterior. Hey divided the posterior flap by transfixion with a catlin seven inches in length, and separated the integuments in the anterior part of the limb along the course of the circular incision. In this procedure, the desirability of dividing the interosseous structures at least half an inch below the point of section of the bone, so that the arteries may not retract beyond reach, should not be forgotten.

Liston's operation is done at the place of election, and consists in a short anterior and a long posterior flap taken from the calf of the leg. Having determined the position of the fibula, to avoid the danger of passing the knife between the bones, the surgeon, standing to the right of the limb, which is elevated by an assistant, places his left index finger on the inner edge of the tibia and his thumb on the posterior edge of the fibula. Then, taking a long catlin and placing its heel immediately in front of the index finger, he makes a semilunar sweep across the front of the leg between the selected points—namely, the inner edge of the tibia and the posterior margin of the fibula—penetrating the posterior tissues of the leg, and transfixing it close behind the fibula, and cutting from behind forwards a posterior flap somewhat longer than the anterior. The anterior flap, consisting mainly of integument and fat, is dissected back, and, the interosseous structures being divided, the saw is applied to the tibia. When the bone has been sawn to at least half its thickness, the handle of the saw should be depressed, to bring the instrument into contact with the fibula, and then both bones are simultaneously divided. The sharp projecting angle of the tibia is removed either by a small oblique section with the saw, or by dividing it with a pair of bone-forceps. The tibial, peroneal, interosseous, and muscular arteries having been secured, the edges of the flap are brought together by numerous points of interrupted suture and the wound is dressed antiseptically.

In estimating the comparative value of the various methods of amputation of the leg in each of the three situations already indicated—viz. the lower, middle, and upper third—the writer is disposed to consider that in the first the 'circular,' or the modifications of it which have been mentioned, notably that of Prof. Syme, will be found most suitable; in the second, the antero-posterior flap methods of Teale or that of Hey must be considered preferable; and in the last situation, or upper third, the amputation by short anterior and long posterior flaps—Liston's or Skey's modification of it, which consists in diminishing the thickness of the posterior flap by not including the tissues in their entirety in it—will give the best results. WILLIAM STOKES.

LEG, Diagnosis of Affections of the. *See* THIGH AND LEG, Diagnosis of Affections of.

LEG, Fractures of the, include fractures of the two bones together or of either the tibia or the fibula alone. Of these injuries fracture of both bones is the most frequent, while fracture of the fibula is more frequent than fracture of the tibia; the relative numbers stated approximately being of both bones eight, of the fibula alone five, of the tibia alone three. Probably, in many cases regarded as fracture of the tibia only, undetected fracture of the fibula has also been present. In infancy fracture of the leg is very rare, while fracture of the thigh is of comparatively frequent occurrence. The explanation probably is that young children, who have learnt to walk only imperfectly, fall with the limbs drawn up so that the force comes chiefly on the femur rather than on the bones of the leg.

FRACTURE OF THE TIBIA most commonly occurs in the lower third, where the bone is smallest. The injury is often caused by indirect violence, such as a fall on the feet, or a sudden wrench of the leg when the foot is fixed; or it may be produced by direct violence—a kick, a blow, the passage of a wheel, &c., in which case any part of the shaft, even its more massive upper end, may be broken. The fracture is generally oblique; most frequently perhaps from above downwards and from without inwards. It may, however, take any other direction. When due to direct violence it is often transverse. Sometimes, the bone is extensively split in a longitudinal direction, the fracture extending into either the knee or the ankle-joint. Owing to the fact that the bone lies so close beneath the surface, and that the break is oblique, so that the upper fragment presents a sharp end, the fracture is frequently either compound at the time, or is rendered so by subsequent movement. Great care should be used to avoid this occurrence during the lifting or undressing of the patient. In falls upon the heel, from a height of even not more than two or three feet, the tibia is sometimes much comminuted and the ankle-joint extensively involved; in other instances, although the fibula remains entire, there is great deformity from displacement of the foot.

Diagnosis.—Fracture of the tibia generally declares itself by displacement, irregularity of the outline of the bone, shortening, mobility of the fragments, and crepitus. In children, and in cases in which the fracture is unattended with displacement, the nature of the injury may very easily be overlooked, especially as the patient can sometimes bear considerable weight upon the limb. In cases of doubt, the bone should be grasped above and below the part at which it is painful or tender on firm pressure, and attempts, but with no undue violence, should be made to move one part on another, first in a transverse and then in an antero-posterior direction, when, if there is fracture, yielding and crepitus will be detected. The knee-joint may be involved either by longitudinal splitting of the shaft, or by separation of one of the tuberosities. A mere fissure of the bone will probably escape notice; but fracture through the tuberosities will be indicated by widening of the head of the bone, irregularity, and crepitus. The joint, in either case, becomes distended with blood and serous effusion, and acute synovitis is often present. After this injury, movement of the joint may be more or less impaired, especially where the fragments cannot be accurately adjusted; or when acute synovitis with much plastic effusion has occurred.

Treatment is the same as that prescribed below for fracture of both *Tibia and Fibula*. When the knee-joint is involved, synovitis must be controlled by the use of ice or cold lotions, and by the maintenance of complete rest; it usually soon subsides. If distension is extreme the joint may be aspirated; but this proceeding is not without risk, and as a rule had better not be resorted to.

Fibula.—This bone may be fractured in any part of its length, but the great majority of the cases involve the inferior third of the shaft, within four or five inches of the tip of the malleolus. The injury may result from direct violence, but it is much more commonly produced by falls in which the foot is twisted upon the leg, sometimes with inversion, but more often with eversion.

Fractures of the shaft may take any direction, and may be multiple or comminuted; they are rarely compound. Fracture through the malleolus, due to sudden inversion of the foot, is generally transverse. In Pott's fracture, the fibula is broken from two to five inches above its lower end, the foot is dislocated outwards, and either the internal malleolus is wholly or in part torn off, or the internal lateral ligament is ruptured. When the fibula alone is broken, displacement of the fragments is usually slight. Cases are on record in which, either by direct violence or by the action of the biceps, the head of the fibula has been detached and the peroneal nerve injured, so that the anterior muscles of the limb below have remained paralysed.

Diagnosis.—The detection of fracture of the fibula is often very difficult, especially in a stout limb, and no doubt many cases are regarded as merely severe sprains. The best method of examination is to make firm pressure with the tips of the fingers along the course of the bone, when sharp pain will be produced as the site of the fracture is reached; and at the same time crepitus or a sharp click may perhaps be noticed. Or, when the fingers are placed on the lower end of the bone, an inch or two above the malleolus, and firm pressure is made upon the shaft higher up, if the bone is entire it may be felt to yield and recoil like a spring, while, if fracture is present, this transmitted movement and elastic recoil will not be observed.

Treatment.—When there is no displacement, the limb may be kept at rest on a pillow and be covered with cold lotion till swelling has subsided, and may then be enclosed in a light case of plaster of Paris or in carefully moulded leather or other splints. At the end of a month the apparatus may be removed, and the patient may begin to use the limb.

In Pott's fracture, or whenever there has been marked deformity at the time of the injury, great care must be taken to correct the displacement, and the limb should be placed in the apparatus recommended for fracture of both bones; or Dupuytren's inside splint may be employed. At the end of a month a plaster case may be applied, so that the patient may be on crutches, but he should not bear on the limb for another fortnight or three weeks. If weight is thrown upon the part earlier than the sixth or seventh week, the torn structures on the inside of the foot are apt to yield, so that aggravated valgus, very difficult to correct, is gradually developed. Another method of treatment is that by the immediate application of plaster of Paris.

Tibia and Fibula.—Fracture of both bones is produced, in almost equal proportions, by direct violence, as by a kick or the passage of a heavy wheel, and indirectly, as in jumps from a height, or by falls in which the leg is suddenly bent. Sometimes a fracture, which may be extensively comminuted, is produced merely by a slip off a step not more than a foot from the ground, or even off the kerb-stone. Fracture of both bones is most common at about the junction of the middle and the inferior thirds of the leg, where the tibia is smallest. It is rare and generally produced only by great direct violence, in the upper third, where the tibia is large and massive. In a few instances, fracture seems to have resulted from muscular action. The two bones may be broken at the same spot, but more commonly the fibula gives way at a higher level than the tibia. The fracture, though usually single, may be multiple or comminuted. Instances have been recorded, in which the tibia has been reduced to four distinct pieces by three lines of fracture. The fracture may extend either into the ankle or, more rarely, into the knee-joint. This complication is alluded to under *Tibia*. The direction of the fracture of the tibia, though sometimes transverse, is generally oblique from above downwards, and either inwards or with an inclination forwards; so that, even where the injury is not at first compound, the sharp end of the upper fragment is very apt to be driven through the skin during the subsequent movement and transference of the patient to bed—an occurrence which should be very carefully guarded against. The relative position of the fragments varies; but along with displacement of the lower fragment upwards, and generally outwards behind the upper, there is often also rotation of the lower fragment outwards by the weight of the foot.

A V-shaped or spiral fracture has been described by M. Gosselin. It is produced by rotation of the leg when the foot is fixed, so that the bones are subject to a violent twist or torsion movement. In this injury, the main fracture is in the shape of a V with its apex pointing downwards; while, from the receding angle presented by the lower fragment, another line of fracture passes in a spiral direction downwards into the ankle-joint, and, after traversing the articular surface of the tibia, ascends along the posterior aspect of the bone, so as to detach a considerable fragment from the lower part of the shaft. This spiral fracture is believed by Gosselin to be due to the wedge-like action of the upper upon the lower fragment, at the moment the bone is undergoing rotation. The injury deserves attention, not only because the ankle is involved, so that more or less stiffness of the joint may result, but because the extensive laceration of the medullary tissue which occurs may be followed, especially when the fracture is compound, by osteo-myelitis. This fracture is difficult of recognition, but the V-shaped outline of the fragments may suggest its presence, while careful examination shows that the ankle-joint is the seat of effusion, and the splintering of the lower end of the tibia may sometimes be made out.

Treatment.—This is best conducted by means of (*a*) a well-padded, iron, back splint extending three or four inches above the knee, curved to fit the limb, furnished with a rectangular foot-piece and with lateral bars for swinging the leg, and having an oval aperture at the lower end so that the heel may be free from pressure; and (*b*) straight side-splints. After the fragments have been adjusted, all shortening having been removed by extension, and care taken to place the ball of the great toe in a line with the inner edge of the patella, the foot is securely fastened to the foot-piece by wide strips of plaster and a bandage, a thin layer of cotton wool being used to protect the skin. Extension being continued, wide bands of strapping are placed spirally round the limb and splint above the level of the fracture, and covered with a bandage which should not be put on tightly. The side-splints are now applied to the inner and outer aspects of the leg from the sole to a little above the knee, and fastened with webbing straps and buckles; they should be a little deeper than the antero-posterior diameter of the limb, so as to project slightly beyond the anterior aspect of the tibia, in order that the webbing straps may stand clear of and not constrict the leg. The limb is then swung beneath a cradle, which should be large enough to prevent pressure of the bedclothes on the foot. This method is so comfortable, that it is advisable to use it even in the simplest cases so long as the patient is to remain in bed; while in complicated, and especially in compound, fractures—in the latter case the side-splints are interrupted opposite the injury—it is the best with which the writer is acquainted. The swinging of the limb enables the patient to change his position in bed without disturbing the fracture; all pressure over the seat of injury is avoided, and, as the seat of fracture is left uncovered, the position of the fragments can at any moment be observed. In the course of three to six weeks, in uncomplicated fractures, the limb may be enclosed in the ordinary plaster of Paris bandage, and the patient allowed to move about a little on crutches.

A plan that was formerly much in favour, and which may still be sometimes used with advantage if the fragments show a tendency to displacement when the leg is placed in the straight position, is to put the patient on the injured side, the leg being flexed on the thigh to relax the muscles and enclosed in lateral splints. It is advisable in all cases to put up the fracture as soon as possible in order to arrest muscular spasm and relieve pain; while the support to the tissues afforded by well-adapted bandages tends to limit effusion and swelling in the parts around the fracture. For a description of Mr. Croft's excellent method, *see* IMMOVABLE BANDAGES. The difficulty sometimes met with in fracture of the leg, of restoring the fragments to place, is best overcome by placing the patient under an anæsthetic and making extension when the leg is bent upon the thigh. Should this method fail, the tendo Achillis may be divided—a proceeding, however, which is seldom called for.

Compound fracture is more commonly met with in the leg than in any other part. The injury is generally the result of direct violence, though it is sometimes produced by falls upon the feet. The extent of the wound varies from a mere puncture of the skin by one of the fragments, or by some sharp body entering from without, to a wide rending open of all the soft parts down to the bone. In severe crushes, the amount of destruction of the soft parts is often out of all proportion to the size of the wound, all the muscles being reduced to a pulp. Sometimes the skin is stripped entirely off; in other cases, the tibial vessels or nerves are lacerated, or the injury extends into the ankle, or more rarely into the knee-joint. In compound fractures generally both bones are broken, though the tibia, or more rarely the fibula, alone may be involved.

Treatment.—By no other example could the improvements recently introduced in the treatment of wounds be more clearly shown, than by that of compound fracture of the leg. In a large proportion of cases, which would formerly have been treated by primary amputation, surgeons now venture on an attempt to save the limb, and the attempt is fully justified by the rarity with which secondary amputation is called for. Whether, in any case, primary amputation should be performed, can be determined only when all the circumstances that present themselves have been carefully considered, both singly and collectively. The following, however, are the main points: If the tibia is so extensively comminuted that, when the pieces which were entirely separated from the periosteum are removed, a very, considerable gap exists between the fragments, the limb would be useless, even if the soft parts should be repaired. Again, if both the tibial arteries are ruptured, and the limb is pulseless and cold, its condition is generally hopeless. But it must not be forgotten that, sometimes, pulsation is arrested by pressure of the fragments or by contusion of the internal and middle coats of the vessel; and therefore, unless bleeding is free, the mere loss of pulsation should not lead us to immediate amputation. Should the anterior tibial be found ruptured, while the posterior still beats, it should be tied; but when the posterior is bleeding persistently from a wound high in the limb, where it can be reached only by a tedious dissection, amputation had better be performed. In children, however, hæmorrhage may, as a rule, be safely dealt with by a well-applied compress. If either of the chief nerves is seen to be lacerated, its ends should be joined by suture. When the muscles are, as is often the case, crushed and minced, they are past restoration; but their mere rupture, or the separation of adjacent muscles by laceration of their sheaths, may be repaired. When the skin has been widely stripped off, especially if the separation extends around the whole girth of the leg, amputation is called for. The condition of the skin should always be carefully investigated. Often, though the wound itself is small, the integuments will be found to be separated over a considerable area.

In practice, the various injuries just alluded to will be met with in all degrees and in all varieties of combination. They must be carefully weighed; but we shall be justified in trusting largely to the means we now possess for turning the balance in the direction of an attempt to save the limb.

HOWARD MARSH.

LEITER'S TUBES are made of flexible metal, with a fine bore through which hot or cold water may be made to circulate. The tubes are coiled up into spirals of various shapes and sizes, and the spirals are loosely connected with bands which allow of their being moulded to flat, hollow, or concave surfaces, and so form a metal surface which will rest evenly on the parts to which it is applied. They may be adapted evenly to the head in the form of a cap, to the throat, eye, chest, abdomen, joints, &c. One end of the tube is placed in a vessel containing water, hot or cold according to the requirements of the case, and the other dips into a receiver on the floor. If the supply vessel be raised and a little suction be applied to the terminal end of the tube, the water will be made to circulate through the coil and will continue to flow by syphon action. Before Leiter introduced metal tubes, coils of india-rubber tubing had been introduced by Richardson and Thornton; but they had certain disadvantages, which do not apply to Leiter's tubes. India-rubber is a bad conductor of heat, and so the water used had to be iced in order to produce the required reduction of temperature; the india-rubber tubes are soft and unsuitable for parts on which the patient rests, as his weight flattens the tubing and arrests the circulation of the water through it; india-rubber has a disagreeable smell. Leiter's tubes are free from all these objections. The metal is a good conductor of heat, and so the water used need not, and in fact should not, be iced; it does not collapse under the weight of the body, and it is free from smell. The tubes may be used for making warm applications at an even or gradually increasing or decreasing temperature, and Leiter has constructed a warming apparatus, through which the water is made to flow before it enters the coils of tubing. Bilton Pollard.

LEMBERT'S SUTURE is employed in closing wounds of the intestine. In such closure it is essential that the two serous surfaces about the wound should be brought in contact, and this is well effected by this particular suture. The needle is first made to pick up a little fold of peritoneum at a short distance (about 3 lines) from the edge of the wound. This fold would not be more than a line or so in width, being merely of sufficient size to afford a hold to the thread. In picking it up, the needle is passed at right angles to the long axis of the wound. A similar fold is now picked up at a corresponding point on the other side of the wound, and when the thread has been drawn through the two folds, and thus carried across the incision, the knot may be tied in the ordinary way. By this suture, the serous surfaces that immediately bound the margins of the wound are turned in towards the lumen of the gut, and are brought into close contact. The needle employed should be curved to the extent of half a circle, should be round on section, and of uniform thickness from the eye to within a short distance of the point. It must be held in a needle-holder.

Hagedorn's flat intestinal needle, and his ingenious needle-holder, are very well adapted for this form of suture. The best material for the ligature is, without doubt, the finest size of 'Chinese twist.'

Czerny-Lembert Suture.—By means of this suture for intestinal wounds much greater security is afforded. The sutures are applied in two rows. The first or inner row includes the mucous membrane only, and is applied in the form of a series of simple suture points. The second or outer row includes the peritoneum only, and is applied in the form of Lembert's suture. As, in wounds of the bowel, the mucous membrane, as a rule, projects conspicuously into the incision, the introduction of the first row of sutures is easy. It is almost needless to say that when the outer series of sutures is applied, the inner set is entirely covered in. Frederick Treves.

LENS. *See* Crystalline Lens.

LENTIGO (*Synon.* Ephelis, Freckles). An increase of the normal pigment of the epidermis in small spots varying from a pin's-head to a hemp-seed or more in size. Freckles are acquired in consequence of hereditary predisposition, and are rare before the age of six and after that of forty, disappearing completely in old age. They occur in persons of both sexes equally, and are met with chiefly, but not exclusively, in persons of fair complexion, especially those who have red hair. They appear chiefly on the face and backs of the hands, and are most strongly marked during the summer and after exposure to the sun; that they are not actually caused by the sun, however, is shown by their occurrence on parts of the body which are covered by clothing, as the buttocks, genitals, and abdomen. During the winter they become much less marked, but do not disappear completely. They consist of a circumscribed hypertrophy of the normal epidermic pigment. They are seen as rounded, oval, or irregularly polygonal spots, neither prominent nor depressed, of a dull yellow to orange or brownish tint. The larger spots (lentigo) have usually a rounded outline, while the smaller ones (ephelis) are more or less angular.

Freckles do not usually call for treatment; but, where they are so copious as to cause disfigurement to any serious extent, a weak lotion of corrosive sublimate may be recommended. John Cavafy.

LEONTIASIS OSSEA is a name given to a form of hyperostosis affecting the facial bones. The disease frequently commences in early life, and gradually encroaches upon the cavities of the skull and face, producing the most hideous deformity. It only very slowly causes the death of the victim, if by pressure it should interfere with any vital function. The osseous masses that are slowly developed about the superior maxillæ and orbits are formed of exceedingly hard compact bone, and are very irregular and nodular. They thus differ from osteoporosis, which has a more uniform outline and is composed of finely reticulated porous bone. They seem to be more of the nature of exostoses. In addition to this fact, the osteoporotic condition which is so well displayed in ostitis deformans does not, so far as we are at present able to judge from the records of cases, affect the bones of the face, but is entirely confined to the calvaria if the head shows any evidence of the disease. *See* JAWS, Diseases of the. H. H. CLUTTON.

LEPRA. *See* ELEPHANTIASIS GRÆCORUM.

LEPROSY. *See* ELEPHANTIASIS GRÆCORUM.

LEUCASMUS. *See* LEUCODERMA.

LEUCODERMA (*Synon.* Leucasmus, Leucopathia acquisita, Vitiligo).—An affection of the skin characterised by the appearance of white or nearly white patches, more or less symmetrically disposed, and due to loss of the normal epidermic pigment. The skin, in the immediate neighbourhood of the white patches, is usually pigmented in excess.

The causes of the affection are obscure; it is commonest in negroes and dark races generally, but not very infrequent in Europeans; it occurs in both sexes, perhaps most frequently in females, and chiefly between the ages of ten and thirty, though earlier and later instances are occasionally met with. A certain number of cases have been observed to follow acute febrile diseases (ague, typhoid fever, scarlatina); in others, pruritus, neuralgia, and various nervous affections and injuries have preceded the pigmentary change, which is most probably directly dependent on the nervous system, in some hitherto unexplained manner.

Pathological examination shows no other abnormality than deficiency or absence of the normal epidermic pigment in the white patches, and excess in the surrounding dark skin; there is, therefore, a simultaneous atrophy and hypertrophy of pigment; in some cases the hypertrophy is generally diffused, and precedes the atrophy by a considerable interval—that is, a diffused chloasma may gradually develop into leucoderma.

The symptoms of leucoderma are entirely limited to the appearance of white rounded or oval spots, neither raised nor depressed, having a convex border, and surrounded by a zone of hyperpigmented skin; they grow slowly, and by their coalescence give rise to large gyrate and irregular figures, the hyperpigmented skin being thus constantly invaded by the leucodermic patches, which ultimately predominate. The process may attack any part of the skin, but is usually most strongly marked over the trunk, especially the loins and abdomen, and the arms and thighs; the forearms and hands, legs and feet, and the face are commonly affected in a lesser degree. When the scalp is attacked, the hair of the affected part becomes white, and the same loss of pigment is found, as a rule, on hairy leucodermic parts of the skin (genitals, axilla); but occasionally the hair retains its colour. Sensation and secretion are perfectly normal. The process is very chronic, often lasting the whole of life; spontaneous improvement has been rarely noticed.

Diagnosis is not difficult. From true leprosy it may be distinguished by the history, the absence of anæsthesia and of other signs of leprosy, and by the sharp outline of the patches and normal texture of the skin; what is called 'white leprosy' in India is, doubtless, only severe leucoderma. Morphœa is followed by loss of pigment, but the affected parts are also generally atrophied and scar-like, and hence depressed beneath the level of the surrounding skin. From chloasma, leucoderma may be distinguished by the concave borders of the pigmented parts; they are convex in circumscribed chloasma.

Treatment is unsatisfactory. No internal remedy is of use, although arsenic has been suggested; locally, all that can be done is to promote removal of excess of pigment by weak lotions of corrosive sublimate, if this should be thought worth while. Any irritation of the white patches, as by mustard for example, may be followed by a return of pigmentation, but this is temporary and irregular, and does not influence the process in the least. JOHN CAVAFY.

LEUCOMA. *See* CORNEA, Ulceration of the.

LEVIS' APPARATUS for the reduction of dislocations of the fingers or thumb consists of a strip of wood, about ten inches long and one inch wide, which is perforated towards one extremity by six or eight holes arranged in two parallel series, and at the other is abruptly narrowed, so as to form a projecting peg around which the tapes completing the apparatus may be secured. The tapes, two in number, are passed through the holes at the end of the piece of wood in such a way that a loop arches across between a pair of holes. One loop should always project from the first pair, and the next may project from the second, third, or fourth pair of holes, according to the length of the digit for which the apparatus is required. To use it, the dislocated finger is placed on the splint and beneath the loops of tape; the loops are then tightened, and the ends of the tape carried along the under surface of the handle of the splint and firmly secured to the projecting peg. The advantages of this apparatus are that the finger is securely and rigidly fixed to a handle, by which extension and leverage can be brought to bear directly on the dislocated joint.

Bilton Pollard.

LICE. *See* Pediculi.

LICHEN.—There are five distinct diseases of the skin to which the name lichen is applied, but it cannot be said that these diseases form a satisfactory group, or that they have any close relationship to each other. They are—(1) lichen planus or ruber; (2) lichen circinatus; (3) lichen urticatus; (4) lichen scrofulosus; (5) lichen pilaris.

Lichen Planus or Ruber.—*Definition.*—An inflammatory disease of the skin characterised by an eruption of large, flat, shining papules of a purplish-red colour, which have a tendency to unite and form raised and scaly patches. The disease is attended with much itching and pigmentation, and with more or less constitutional disturbance.

Symptoms and Pathology.—A well-marked example of lichen planus has very characteristic features; some varieties of the disease are, however, met with in which these typical characters are wanting. The most important of these varieties has been called lichen ruber acuminatus, because the flat top of the papule is absent. In a typical example of lichen planus, the papules are considerably raised above the skin, and vary in size from a pin's head to a split pea; they are often quadrangular or polygonal in form; this is, however, by no means a constant feature, for in many instances they are well rounded. In the centre of each well-formed papule there is a slight depression or umbilication, which in some of the larger papules becomes a crater-like excavation, giving to the eruption a very peculiar and characteristic appearance. With the exception of the central depression, which is not always present, the surface of the papule is flat and glistening until a late stage of the disease, when the shining appearance is generally lost. The colour of the papules is a dull or purplish red, often standing out in marked contrast to the white skin around. In many instances the papules remain discrete throughout, but, in not a few cases, they coalesce so as to form raised and scaly patches closely resembling psoriasis. In very severe cases of this kind, nearly the whole body may be covered with raised scaly patches, and thus many of the distinctive features of the disease may be lost. Severe cases of this kind were first described by Hebra, and named by him lichen ruber; they differ from cases of lichen planus only in the greater extent of skin involved in the disease. Lichen planus is usually distributed symmetrically and most commonly on the flexor sides of the forearms, especially at the wrists; it is, however, seldom confined to that region. The course of the disease is most tedious, so much so that Hebra described the severer forms of the malady as incurable. The itching is usually very great, especially when the papules first appear; as the eruption fades it leaves behind dark pigmented stains, which often last long after the original papules have disappeared. On the whole it may be said that, with the exception of some forms of syphilis, lichen planus produces more pigmentation than any other disease of the skin. In severe types of the disease the constitutional disturbance is great, in which respect it presents a marked contrast to psoriasis.

Etiology.—The causes of lichen planus are quite unknown. It is very rare in young children, and is equally common in males and females. It is true that some observers have thought it more common in men, and others in women; the explanation of this is that they have not drawn their conclusions from a sufficient number of cases. The disease is comparatively rare.

Diagnosis.—There are only two diseases with which lichen planus can be confounded—viz. dermato-syphilis and psoriasis. In its discrete form it may be distinguished from any syphilitic eruption—(1) by the umbilicated form, peculiar colour, and arrangement of the papules; (2) the intense itching; (3) its distribution and symmetry; (4) the absence of any symptoms of syphilis; in short, the only point in which it closely resembles a syphilide is in the dark pigmentation produced. In the confluent form it certainly bears a close resemblance to psoriasis or a scaly syphilitic eruption; the great irritation and the history serve to distinguish it from the latter disease, while the out-lying papules, dark pigmentation, distribution, and constitutional disturbance help to distinguish it from the former.

Treatment. — Of internal remedies, arsenic and perchloride of mercury are the only two which have any distinct or definite value; of local remedies, weak alkaline baths are often very useful in relieving the intense itching. The baths may be followed up by sponging with liquor carbonis detergens lotion. A useful lotion of this kind is ℞ Liq. carbonis detergent. f℥ss., Glycerini, f℥ss., Liq. plumbi subacetatis dil. Oj. A nitrate of silver lotion (gr. iij. ad f℥j.) often relieves the irritation when the tar lotions fail. A perchloride of mercury lotion is also sometimes useful for the same purpose.

Lichen Circinatus is a fairly well defined though not very important affection of the skin. The eruption is met with chiefly on the chest and back, where it is apt to form a triangular patch, the base of which is directed upwards towards the shoulders and the apex towards the lumbar region. The eruption consists of minute reddish papules, some of which are discrete, while others are arranged in small rings or parts of circles; these rings spread centrifugally, leaving a central space of smooth slightly pigmented skin, the yellowish pigmentation giving the disease a superficial resemblance to pityriasis versicolor. Although the disease is most common on the chest and back, it is not strictly confined to those regions; it is attended with itching, which is not usually excessive. It is easily cured by the internal administration of arsenic and the local application of boracic acid or borax lotion.

Lichen Urticatus (*Synon.* Urticaria papulosa).—This disease has, in the opinion of the writer, more marked affinities with urticaria than with lichen; nevertheless, the large size and persistent character of the papules separate it very distinctly from ordinary urticaria. The older writers describe it as a mixed eruption of urticaria and lichen. The disease is met with almost entirely in children, and is very obstinate, usually lasting for several years, but with intervals of comparative subsidence; the itching and irritation are very great, especially at night, and this is always aggravated by the scratching of the patient, which can hardly be prevented. The disease is common amongst the poor, and not uncommon amongst the well-to-do classes in England. It is often mistaken by beginners for scabies, for the reason that in both the superficial characters are greatly due to scratching; for the same reason, the eruption set up in some children by pediculi and other insects may be easily mistaken for lichen urticatus. The difference, however, is soon evident, for, when the insects are removed the eruption disappears, and in this respect it differs, of course, entirely from true lichen urticatus, which is one of the most obstinate affections of the skin. The treatment of the disease consists—(1) in the removal of all local causes of irritation, such as flannel and stimulating soap; (2) in carefully regulating the diet, which should be of a highly nutritious but simple kind; (3) the administration of small doses of arsenic with alkalies and mild purgatives; (4) the local application of lotions and powders to relieve the itching.

Lichen Scrofulosus cannot be regarded as an important disease of the skin. It was first described by Hebra as almost exclusively met with in scrofulous people; it may, however, be fairly doubted whether he did not lay too much stress on this feature of the disease. The eruption has the following characters: (1) the papules are of a very pale colour, and about the size of small pins' heads; (2) they are arranged in patches more or less circular or ringed; (3) the eruption is most common on the trunk, less common on the limbs; (4) it is unattended with itching, and this is its most characteristic feature; (5) it is chiefly met with in children and young people; (6) it is sometimes followed by slight pigmentation and desquamation. The absence of all itching and irritation, and the pale and superficial character of the eruption make it easily overlooked, which is not a matter of much importance. In general appearance it resembles a superficial papular eczema, but can easily be distinguished by the absence of all subjective sensations. Its affinities are rather with lichen (keratosis) pilaris. Besides the above described form of lichen scrofulosus, there is also another variety in which the papules are larger, more discrete, and of a much brighter colour, but in which the *characteristic* feature of not itching is present. In the treatment of this disease, the internal use of cod-liver oil has been strongly recommended by Hebra. Arsenic is also very useful.

Lichen Pilaris, or Keratosis Pilaris as it is now usually called, is a hypertrophic affection of the hair-follicles rather than a true inflammation. The general appearance of this disease is that of a persistent cutis anserina. It is due to an over-distension and sometimes hypertrophy of the hair-follicles; this distension is caused by an accumulation of epidermic structures and sebaceous matter which collects around the hairs, and forms pale, firm papules about the size of small pins'-heads, or sometimes larger. In well-developed cases the papules are very numerous, and when the hand is passed over the surface of the skin it feels like a fine nutmeg-grater. The usual seat of this affection is the trunk, and the extensor surface of the limbs. It occasionally happens that the papules become a little inflamed, and then assume a red appearance which is attended by some itching; otherwise the patient is free from subjective sensations, and the papules are of the same colour as the skin. It is probable that this inflammation is simply accidental, and not an essential part of the malady.

Diagnosis.—There are two affections of the skin with which keratosis pilaris may easily be confounded—namely, lichen scrofulosus and the papular or follicular form of ichthyosis. From the former it may be distinguished—(1) by the hardness of the papule, and its obvious formation from over-distension of the follicle; (2) the arrangement of the papules, there being no tendency to form round or ringed patches; (3) the history of the case. From follicular ichthyosis it may be distinguished by the fact that keratosis pilaris is an acquired disease; but the two affections bear a very close superficial resemblance to each other. The treatment consists in the use of warm alkaline baths and the free inunction of glycerine. Robert Liveing.

LIGATURES.—Hæmorrhage is best arrested by a simple ligature of the cut ends of the vessels. Large veins, when divided, occasionally require ligature. It is best to include as little of the surrounding tissue as possible, except when the arterial coats are diseased. Occasionally, as with the pedicle in ovariotomy, or the stump after hysterotomy, the vessels are best secured *en masse.* Growths such as nævus or hæmorrhoids may be treated by ligature.

Materials innumerable have been employed for the ligature of arteries. The best are silk and hemp, catgut, tendon, or ox aorta. Those ligatures are best which are most easily prepared. All ligatures should be perfectly aseptic; silk can be kept constantly in carbolic solution; the catgut in common use (from the intestines of the sheep) can be prepared best in carbolic or chromic acid. For the cut ends of arteries, catgut, when properly prepared, is the best material. The carbolised catgut should be removed from the oil and soaked for at least twelve hours in an antiseptic solution, but chromicised catgut may be kept dry, and only requires soaking in carbolic lotion for half an hour before use. The ligature then ceases to be slippery or brittle, and the knot will not yield. Animal ligatures disappear in the course of time, leaving the artery occluded, without setting up irritation. Silk ligatures, if really aseptic, may do the same, but frequently fail in this respect. Whatever the material employed, the inner coats of the vessel are usually ruptured; the flatter the ligature the less likely is this to happen. Secondary hæmorrhage is more likely to follow the use of silk than of animal ligatures. For the ligature of arteries in their continuity, animal substances are best. A single thread should always be used.

Method of Tying.—A reef-knot should always be used, and the knot made firmly without any jerk. In tying arteries in their continuity, the dissection should be carried down till the white coat of the vessel is exposed, and the ligature applied with a minimum of disturbance to the sheath. The artery should not be separated from its vascular connections for more than the width of the aneurism needle. By pressing the tips of the fingers down on the vessel in tying the knots, the danger of lifting up the artery from its bed will be obviated. The ends can be cut off short, and the cut sheath should meet over the knot when the wound is closed. Often, the internal coats can be felt to give way as the first knot is made, and when this happens, it is a proof that sufficient force has been exerted. The internal coats are ruptured with far greater ease than might be supposed. In a healthy artery, the absolute cessation of the pulsation below indicates that the vessel has been tied sufficiently tightly. The swelling of the ligature which follows when an animal material is employed, is more likely to increase the constriction than to diminish it, as usually supposed; for the knot, if properly tied, does not yield with the swelling of the ligature. The more diseased the vessel, the more deliberately should the first knot be made.

In dense, fibrous tissues, it is often very difficult to secure a bleeding point with the ligature. A good plan then is to pass a needle, threaded with a double ligature, through a portion of tissue near the vessel, as in acupressure. The loop is cut and both ligatures are tied, one on each side of the bleeding point. They are thus prevented from slipping off, and one or other will certainly include the vessel. For tying thick ovarian pedicles, and, still more, in tying the stump after removal of the uterus, silk ligatures are best. Spencer Wells's twisted silk is far the strongest and most reliable. Here, the first knot should be made with a double hitch, and tied very slowly and firmly; if the loose ends are pulled across each other the knot will not slip. After a few minutes the loop will be found loose as the fluids are pressed out; the knot is then again tightened. This process may require to be repeated several times before the reef-knot is completed; if this be not done, hæmorrhage is apt to follow. C. T. Dent.

LIGHTNING, Accidents from. — These injuries seldom come under the notice of surgeons in this country, and most of our knowledge of the subject has been derived from the records of cases collected, from several sources, by Sestier and Boudin, and from the results of experiments made by Dr. Richardson in 1869. These injuries vary much, in different cases, in their character, intensity and extent, and though due in most instances to the action, more or less direct, of lightning, are at times the results merely of alarm and mental shock. In the most severe and fatal instances, the proportion of which to all the cases of injury from lightning is about one to four, the patient is killed at once, the body either falling suddenly to the ground, or becoming rigid and remaining fixed in a more or less erect attitude. In the more severe cases of the non-fatal injuries, the most marked general symptom is sudden and very profound collapse with unconsciousness, which condition is followed by drowsiness, fever, much prostration, and occasionally delirium and convulsions. A very frequent result of the injury is temporary paralysis of one or more limbs, associated in some instances with severe neuralgic pains, in others with complete anæsthesia of the paralysed region. Impairment of vision, and even blindness, have frequently been observed in cases of lightning injury, and these sequelæ, unlike the other results of lightning injuries, have in many cases a tendency to persist, especially when due not to nervous shock, but to progressive inflammatory changes in the choroid and retina. The long list of affections, that have been recorded as remote sequelæ of accidents from lightning, includes general debility, muscular weakness, vague fugitive pains, loss of memory, impairment of smell and taste, feeble circulation, coldness of the extremities, and the other well-known subjects of complaint common in those who have recovered from severe shock.

The external lesions caused by lightning also vary to a considerable extent, even in fatal cases. A person killed on the spot may present hardly any visible mark of injury, whilst, in some instances, the body may be much mutilated, and the bones of a limb or of the cranium widely comminuted and exposed. The clothes, in fatal as in less severe cases, may be left untouched, but are usually burnt and perforated at scattered points or along extended lines; or are reduced to shreds and torn away, leaving more or less of the patient's body quite bare. The most frequent superficial injuries from lightning are patches of cutaneous ecchymosis, burns varying in extent and severity, and dusky patches on the surface of the skin caused by the deposition of fused portions of metallic bodies—chains, coins, studs—carried by the patient at the time of the injury. Much attention has been directed to the so-called *keraunographic* images or arborescent impressions, that have been occasionally observed in cases of injury from lightning. These patches, presenting deep red lines, having a decided arborescent arrangement, correspond to the distribution of one or more subcutaneous veins, and are probably due, like similar appearances in the decomposing cadaver, to effusion of fluid blood along the course of the venous trunk and its branches. Arrest of the growth of the hair, followed by complete general or localised epilation, is another frequent result of these injuries.

In fatal cases of lightning injury, rigor mortis comes on rapidly, but the coagulation of the blood is usually much retarded. The most frequently observed post-mortem appearances have been: circumscribed effusions of blood under the serous membrane of the large cavities, extreme vascular injection of the coats of the intestines, and distension of the cerebral veins and sinuses. Instances of rupture of the heart, and also of the stomach, have been recorded.

In the *treatment* of severe lightning injuries, the surgeon has to deal at first with the condition of shock by applying warmth to the surface of the body, by administering stimulants by the mouth, rectum, or under the skin, and, in very severe cases, by artificially inflating the lungs. Each of the secondary and local affections requires the usual treatment of such condition. Under the influence of a proper and regular course of galvanism, the localised paralysis in most instances very soon yields. The progress of healing of the burns caused by lightning is often very slow, and in such instances, it has been stated, the action of the ordinary local remedies will be much assisted by the occasional application of electric currents to the injured region. W. Johnson Smith.

LINGUAL ARTERY, The, arises opposite the greater cornu of the hyoid bone, and, passing inwards parallel to the greater cornu and a quarter of an inch above it, finally ascends to the tongue.

The artery is divided into three stages by the hyo-glossus muscle, which crosses it—viz. a part posterior to, a part beneath, and, finally, a part anterior to the muscle. The second stage is the important surgical one. The digastric and stylo-hyoid muscles cross the artery obliquely, and divide it into two regions; the one below belongs to the superior carotid triangle, the one above to the submaxillary. The artery rests at first upon the middle constrictor, afterwards upon the genio-hyo-glossus.

Ligation.—Make a straight incision along the upper border of the hyoid bone for an inch and a half, dividing the cutaneous structures. When the deep fascia is opened, the posterior belly of the digastric is to be plainly made out; the hyo-glossus is then seen, with the hypo-glossal nerve and the lingual vein lying on it. Pull upwards the digastric and stylo-hyoid muscles, the submaxillary gland, the hypoglossal nerve, and the lingual vein. The hyo-glossus muscle being freely exposed, cut it lengthwise on a director immediately above the hyoid bone, where, beneath the muscle, the artery is found and secured. It is best to fix the hyoid bone by a tenaculum or forceps whilst the director is being passed beneath the muscle. Pass the needle from above downwards.

James Cantlie.

LINHART'S CHISEL. *See* Osteotomy.

LIPOMA (Fatty Tumour).—Three varieties of fatty tumour are recognised: The diffused. The single (fatty tumour proper). The multiple.

The *diffused* form is comparatively rare, unless the common 'double chin' be regarded as a growth; yet certainly in this region, as well as in those of the parotid, the sub-occipital, and in many others, usually near to the mesial line of the trunk, are to be found occasionally such definite masses of subcutaneous fat that the name of 'tumour' must be applied to them. Beneath the chin and in the perineum these swellings may seem single, but, otherwise, it is usual to find these lumps of fat placed symmetrically, and often there are many of them; and as the double chin is generally seen in men, so are these diffused fatty growths almost always found in men, and almost as constantly in young men.

The *single* variety is the well-known 'fatty tumour,' whose *locus* is always the areolar tissue, and which most frequently is subcutaneous; but lipomata may be found occupying inter-muscular spaces or forming an omental mass, occurring usually as a single tumour, though two placed symmetrically or more may exist in the same patient. Women appear to produce this form of lipoma more frequently than do men; certainly women seek advice for their removal in greater numbers than men, and although commonly seen in well-nourished subjects, this is by no means universally the case.

Fatty tumours occur most frequently upon the posterior plane of the body, and as a rule nearer the lateral borders than the spine; thus, favourite sites are the nape of the neck, the shoulders, and the scapular area generally, as also lower down the trunk, over the loins, the nates, and the region of the great trochanters. Sometimes, these fatty tumours shift their position by a process of gradual downward displacement, caused by their own weight acting on loose connections, and thus pendulous or even pedunculated fatty tumours are produced. They are at first usually of slow growth, but at any time are liable to increase rapidly. The largest the writer has seen grew from between the scapulæ, and weighed thirty-seven pounds.

The *multiple* variety, where three or more may exist in the same person, are usually found upon the extremities, the upper more often than the lower, and rarely grow larger than a filbert.

Causes.—A possible cause for the occurrence of diffused lipomata appears, by recent observations, to have been found in the fact that subjects of this affection are large consumers of ardent spirits. In the case of the common fatty tumour, taking into consideration the situations where these tumours are wont to be found, and that not infrequently such parts are subjected to pressure—as for instance the points of the shoulders in lying—it would not seem unreasonable to suppose that local irritation, inducing hyperplasia, may be regarded as a frequent exciting cause, whilst a general disposition to the over-production of fatty tissue is usually the predisposing cause. Family predisposition is often the cause assigned by the subjects of multiple lipomata.

Pathology.—As regards minute structure and arrangement, the microscopic appearances of the lipomata do not differ from those of normal fatty tissue. On inspection, after removal, a fatty tumour is seen to be made up of a series of lobes, with a very varying amount of fibrous tissue which radiates through the tumour, and also forms its capsule. This capsule is complete in the *single* and *multiple* forms, but, as its name infers, is wanting either altogether or in part in the *diffuse*. Lipomata are feebly vascular. They stretch the skin covering them and attenuate it, so that, either from friction or neglect, it may ulcerate and allow the tumour to herniate. The only form of degeneration that is common in fatty tumours is calcification.

Diagnosis.—The diffused lipomata vary in consistency, being either soft and doughy, or very hard and dense. They have indefinite borders, which fade off into the normal subcutaneous fat at some one aspect or in all directions; the skin is generally so closely blended with the fatty mass that it cannot be raised off the tumour, nor this from off the subjacent tissue. Lobulation may be very imperfect in this variety.

In a typical fatty tumour of the single class there is a well-defined roundish or oval swelling, the skin is commonly puckered over the tumour and loosely adherent to it, whilst the growth can be lifted up from off the subjacent structures. The tumour is easily displaced; it is soft and lobulated, and the softness and elasticity of these tumours is often so marked as to give rise to a most deceptive sense of fluctuation. Often fatty tumours are flattened out, and, as has been stated, they may be almost pedunculated, and this is likely to be the case when they are connected with the axilla or perineum. A fatty tumour has in the first place to be diagnosed from a sebaceous cyst, to which the skin is more closely adherent, and on the surface of which a black spot marking the obstructed orifice of the duct can often be seen; in the second place, from a chronic abscess or other fluid swelling, in which case, if doubt exists, aspiration will clear it up. Almost the only inconvenience which a fatty tumour produces is from its size. It is very seldom that patients make complaint of pain.

In the multiple variety, the little fatty masses are firmer, but still lobed, and often one or more are very painful on pressure; this form drifts into and can hardly be separated from the painful subcutaneous fibroma, the relative amount of fatty and fibrous tissue, and the more or less definite evidence of nerve-filaments forming a part of the growth, determining the point.

Treatment.—For the diffused lipomata, operative procedure is, as a rule, contra-indicated. A reform of the tippling habits, and the use of medicines which tend to cause absorption of the masses of fat, seem the more suitable plan of treatment, although, if very large and disfiguring, free cutting out of the overgrown structure may be performed.

Ordinary single lipomata should be removed by a free incision and enucleation of the growth; and, as the writer has seen recurrence follow an operation, a word of caution may be added, to remove the tumour thoroughly, for a small outlying lobe may very easily escape observation.

Multiple lipomata, it is clear, cannot be all excised; if one or two are the cause of much pain, they may be taken out; but here again the internal administration of such drugs as liq. potassæ in large doses, arsenic, iron, and iodine, forms the most appropriate treatment, together with strict regimen. ALFRED WILLETT.

LIPS, Diseases of the.—*Malformations* of the lips are described under CHEEK, Fissure of the; HARE-LIP; NÆVUS.

I. *Cracked lip*, though usually the result of dyspepsia or local irritation, may owe its origin to scrofula or syphilis. The simple variety is generally seated in the centre of the lower lip. There is little, if any, induration; the mucous membrane around may be more or less chapped. In slight cases no treatment is required, but if the fissure is obstinate it should be touched with lunar caustic, or anointed with some mild mercurial preparation. Healing may be hastened by checking the action of the labial muscles, by means of a piece of strapping passed below the lip from cheek to cheek.

II. *Ulcers of the Lip.*—(*a*) *Simple follicular ulcers* are frequently associated with disordered digestion. They are rarely larger than grape-seeds. Their edges are steep and sharply cut. They give rise to smarting pain, which is increased by mechanical or chemical irritation.

Treatment.—Any digestive errors are to be corrected by a saline purge and an alkaline-bitter tonic; and the ulcers touched with some mineral astringent.

(*b*) *Syphilitic* ulcers are of three kinds: (1) the primary sore or chancre; (2) secondary fissures and mucous tubercles; and (3) tertiary serpiginous sores.

Hard chancre may be acquired in various ways—e.g. the virus may be conveyed by the saliva, or by the secretion from mucous tubercles on the lips of another person, in the act of kissing; or it may be carried by a pipe, drinking-glass, or toothbrush. Occasionally, inoculation is the consequence of lascivious practices. Infants may be infected from the cracked nipples of wet nurses the subjects of syphilis. As a rule, the chancre is less indurated than when seated on the genitals; its base may be purulent, sloughy, or even hæmorrhagic. On the other hand, the local signs may be so slight that the patient may not notice them. The lymphatic glands beneath the jaw, which are the seat of indolent bubo, are affected quite early. The other constitutional symptoms are not long in making their appearance. It is difficult, and it may be impossible in the early stages, to distinguish an infective from a non-infective chancre.

Treatment.-The ulcer should be covered with crystalline iodoform until it begins to heal, and the red oxide of mercury ointment then be applied.

Mucous tubercles are situated at the angles of the mouth and on the inner surface of the lips. The *cracks* or *fissures* of congenital syphilis often leave indelible scars, radiating from the corners of the mouth.

Treatment.—The broken surfaces should be brushed over with a solution of bichloride of mercury, $\frac{1}{4}$ to 2 grains to the ounce.

Tertiary syphilitic ulcers begin on the cutaneous surface, generally of the upper lip. They are often coated with thick foul scabs. The local *treatment* is the same as for the primary ulcerated chancre.

In each of the foregoing varieties of syphilitic ulcer the constitutional affection requires systematic treatment. Strict injunctions should be given to the patient to guard against conveying infection to others.

(*c*) *Scrofulous ulcers* consist of cracks or fissures: not rarely the muco-cutaneous surface is the seat of eczema. In addition to or even without ulceration, the upper lip may be permanently swollen from solid œdema, the result of chronic inflammation. The lip is prominent and carried away from the teeth. This is known as *Strumous lip*.

Treatment.—The digestive organs must be attended to, and cod-liver oil and iron administered. The fissures and eczematous patches may be painted with a mixture of equal parts of castor oil and oxide of zinc, or touched lightly with nitrate of silver.

(*d*) *Epithelioma* in its early stages resembles simple warty proliferation. On section, however, it will be found that in papilloma there is no invasion of the cutis vera, whereas in epithelioma the cutaneous and subcutaneous tissues are involved quite early, and at the same time there is induration of the base of the growth. The disease is infinitely rare in females. It is seldom met with under thirty, and, like other forms of cancer, it occurs with increasing frequency as age advances. With very few exceptions the lower lip is the part attacked. The rate of growth and ulceration varies within wide limits. At first the surface is merely cracked, or irregular from papillary hypertrophy. A little later it is covered with a scab, which on being removed leaves a granular-looking sore. On squeezing the part it may be possible to express some plugs of epithelium. As the destructive process advances, the part assumes a ragged, ulcerated appearance. The submaxillary glands become involved, and the gum or even the jaw may be implicated in the growth.

Diagnosis.—It is only in the initial stages that a doubt can arise as to the nature of the lesion.

From papilloma it is told by its tendency to ulcerate; by the induration of its base; by the possibility of dislodging epithelial-cell cylinders; by the enlargement, if any, of the submaxillary lymphatic glands; and lastly, in many cases, by the duration of the disease.

Epithelioma is more commonly mistaken for a hard chancre, and *vice versâ*; but a chancre is less warty or otherwise irregular, and the induration is more uniform and circumscribed. Again, the lymphatic glands are affected at an earlier date in chancre, forming indolent bubo. In the majority of cases, epithelioma is met with later in life than labial chancres, which are not infrequent in women. Corroborative evidence will be furnished by the absence or presence of other symptoms of syphilis, taken together with the known duration of the affection. When once the skin or mucous membrane has been destroyed by a syphilitic ulcer, no epithelium is found in its base, whereas in epithelioma it is quite plentiful.

The writer's experience leads him to conclude that no great reliance can be placed on the results of microscopical examination of scrapings from the surface. It is quite possible to mistake the tips of hypertrophied papillæ for cell-globes.

Treatment.—Nothing short of complete removal is of the least avail. The usual plan of operation is to excise the growth with the entire thickness of the lip, by means of a V-shaped incision. Care must be taken that the cuts are made quite clear of the diseased tissues, otherwise recurrence will be certain and speedy. There can be no doubt that, when practised early, this plan of treatment suffices to effect a permanent cure in some cases. Even when the gum or jaw is deeply invaded, the surgeon should advise an operation if the whole of the tumour can be got away, and the condition of any infiltrated cervical glands is such as to allow of their complete extirpation. If the disease is left to itself there is but one termination—death, and that in a horribly distressing form; the patient being worn out by absorption of septic matter from the ulcerated gangrenous tissues; by repeated attacks of hæmorrhage, which it may be difficult to arrest, and by the passage of decomposing discharge into the stomach and lungs. For the more serious operations, no rule can be laid down with regard to the incisions suitable to all cases. It may be expedient to close the gap left after removal of the mass by means of a plastic operation. The directions for such a procedure will be found under CHEILOPLASTY. It may be added that these extensive operations are the more justifiable, since it is quite exceptional for the viscera to be affected with secondary growths. It is surprising what little deformity is left, even when the greater part of the lip has been excised.

III. *Adenoma of the lip* commences in proliferation of the glandular epithelium. It is composed of tubes and acini, the latter predominating. It is a rare affection, and generally slow in its march. The inner surface of the tumour, which is covered with mucous membrane, may be flattened by pressure against the teeth and gums, whilst the outer surface presents a uniform swelling under the skin. In addition to the glandular structure there may be a considerable quantity of fibrous and mucous tissue; in fact, these growths bear a strong resemblance to the mixed tumours of the parotid. In one case the growth contained a nodule of bone. Occasionally they are cystic.

Treatment.—If possible the tumour should be enucleated without dividing the lip. The best plan is to make a free incision over the inner surface of the swelling.

IV. *Labial cysts* arise for the most part from distension of mucous follicles, but there may be free cyst-formation, possibly from dilatation of lymphatic spaces. They can generally be seen projecting beneath the mucous membrane as semi-transparent vesicles, as if a white grape were embedded in the tissues of the lip. The contents are usually viscid, and are either colourless or yellowish.

Treatment.—If small, the entire cyst may be removed; but, rather than damage the surrounding structures, it is better to excise a portion of the cyst-wall. In the latter case to prevent refilling, the inner surface should then be rubbed with solid silver nitrate or brushed over with strong nitric acid.

V. *Herpes labialis* is commonly seen as a crop of vesicles at the junction of the skin and mucous membrane. *See* HERPES.

VI. *Pigmentation* of the mucous membrane of the lip occurs as patches in Addison's disease. It is of no surgical import.

VII. *Aneurism by anastomosis* of the facial artery and its branches may involve the lip. *See* CIRSOID ANEURISM.

AUGUSTUS J. PEPPER.

LISTER'S SPLINT for excision of the wrist is an anterior forearm splint, with a cork pad at one end for the hand to rest upon with the wrist extended and the fingers slightly bent, and a cork ledge projecting on the radial side for the thumb to rest upon.

LISTON'S LONG SPLINT is a wooden splint, reaching from the axilla to six inches beyond the sole of the foot. It has two notches at the distal end so as to give the ankle bandage a firmer grip of the splint, and two holes at the other end for the perineal band to be attached to. The middle of the band should be accurately adjusted over the ischial tuberosity, and its two ends should be carried, one in front of the groin and the other behind the buttock, to the holes in the axillary end of the splint. Extension should be made by pulling on the foot and the lower end of the splint, and then the ends of the perineal band should be tied together to maintain the extension.

BILTON POLLARD.

LITHOTOMY. — This and the next article deal simply with the surgical treatment of stone in the bladder by operation —the varieties, the obstacles and dangers met with, the results, and the applicability of each method of proceeding. For the symptoms, diagnosis, and medical treatment of stone, *see* STONE IN THE BLADDER. The writer has not attempted to treat the subject exhaustively; he has been compelled to omit many references to authorities, and even to leave unnoticed varieties of instruments and operative measures which are now but seldom used or adopted. He has rather aimed at giving, in a concise and practical manner, his own reflections on lithotomy and lithotrity, formed after a fairly long and full experience extending to just 300 cases of operation in his own practice, and probably as many more in that of his colleagues and friends.

Not all patients who have stone in the bladder should be advised to submit to operation. Some suffer so little from the presence of even a very large stone, that it would be wrong to place their lives in danger by resorting to lithotomy; while some others are unfit for any operation because of the presence of serious organic disease, urinary or otherwise. Let it now, however, be assumed that, after due consideration, a patient is about to undergo an operation.

LATERAL LITHOTOMY IN THE ADULT.—The instruments required are, or ought to be, few. Staffs, a knife, Prichard's anklets, forceps, scoops, a sound or searcher, possibly a blunt gorget, a drainage-tube, a tampon, and a syringe, are all that can be required.

The staff should be of moderate rather than of full size (the former is just as easy to find, and does not oppose the introduction of the finger so much as a large one), with not too long a curve or too sharp a point, for fear of injuring or even perforating the posterior wall of a contracted bladder; the lateral groove should be wide rather than deep, and extend to and end abruptly at a quarter of an inch from the end. The knife usually sold as Liston's is the best shape, with the back nearly straight, of a good width, the cutting edge terminating an inch and a quarter from its point; the blade three, and the handle four, inches in length. The forceps should be always straight—curved are unnecessary and inefficient—the blades sufficiently hollowed that they will hold a stone fairly by their surfaces and not merely by two points, and yet not so hollowed as that the tips of the blades would be likely to break the stone if only half-grasped; the inside of the blades should be roughened, or, what is better, lined with linen, which diminishes the risk of breaking the stone. The scoops usually sold are of little use; they should not be double-ended, but firmly fixed in a good-sized bone or wood handle, of various sizes, and well curved, so that if a stone or piece of stone is fairly engaged in one, it can be withdrawn by a combination of traction and leverage. The gorget can seldom be needed; for upwards of thirty years it has scarcely ever been used in Norwich, and now the hospital does not possess one. Cases frequently occur in which the finger cannot reach the bladder; but the forceps will always readily enter it and will act as the best dilator. A tube of some kind to secure, after the operation, perfect drainage and repose of the bladder is of infinite advantage. It is usually made of gum-elastic material, but many years ago the writer suggested the use of a double silver canula, sheathed so that it can be drawn out according to the distance of the bladder from the surface; it should be about the size of No. 18 catheter, with a well-bevelled end and numerous small holes for about an inch. These small apertures are better than one or two larger ones, because if the tube has to be retained several days, the swelling of the wound's surface may cause the granulations to bulge into these apertures and make its withdrawal painful, and even cause a little bleeding.

No special preparation of the patient is called for beyond a judicious diet for a few days, a mild laxative if necessary, and an enema shortly before the hour of operation. The table for the patient and the chair for the surgeon should be of such relative heights, that the latter can easily proceed without having to raise his hand and arm uncomfortably.

While the anæsthetic is being administered, the anklets may be adjusted. The two assistants who support the legs must be mindful of their duties, which are, to keep the patient in a straight and immovable position, with his thighs well flexed on the body and the knees symmetrically separated. This is best done by folding one arm over the patient's knee, with the forearm and hand along the inner side of the leg, the other hand supporting the foot, but ready at any moment to assist the operator if required. The staff may be introduced either before or after the anklets are locked; if before, care must be taken that it is not driven in upon the bladder during the rough movements of flexing the legs. The presence of a stone will be verified by the staff; if any doubt on this point is felt, a sound should be substituted and a proper search made, and if still the stone cannot be detected, the operation must be postponed. This, however, will very seldom happen; in several hundred operations the writer has only once known it occur, and that was in the practice of Mr. Liston. The patient, a fat, elderly man, with an enlarged prostate, had twice been removed from the table; on the third attempt, although the stone had been felt the day before with the sound, the staff did not strike it at the time of operation. When the bladder was opened and the forceps were introduced, still no stone could be felt; there was free bleeding, and a clot was entangled in the blades of the forceps, and in this clot were two small stones which had been unconsciously removed. The position of the staff is a matter of importance: instead of keeping its handle perpendicular, the staff-holder should incline his hand considerably towards the patient's abdomen, and gently push the convexity of the staff towards the perineum. The effect of this, as verified by dissection, is to bring the membranous urethra slightly nearer to and almost parallel with the surface of the perineum; the groove is more easily reached, the operator has no inducement to open the urethra too far forwards, and the bulb and its artery will probably escape being cut. The end of the staff need not, by this plan, be withdrawn from the bladder; but if it were, it would be immediately replaced when the staff is brought into the perpendicular position and hooked firmly under the pubic arch, before the deep incisions are made.

Before commencing the operation, the finger is passed into the rectum to ascertain that it is empty, to note the size of the prostate, and to secure the proper position of the staff. The first incision should be about three inches in length or more, according to the estimated size of the stone and of the prostate; the freer the incision, the easier it is to bury the knuckles in it and reach a deeply-placed bladder. The knife is entered perpendicularly rather more than an inch above the anus, and a little to the proper left of the middle line; this first puncture should be of some depth, but not deep enough to touch the staff: should it do so, it may be assumed that the urethra has been opened too far forward, and free bleeding may be the needless result. The direction of the incision should be well towards the tuberosity of the ischium—nearer, that is, to it than to the anus. The left forefinger is then pressed deeply along the upper angle of the wound, and the staff felt for; it can always be found, but it is not easy to place the finger-nail on the edge of the groove. This would require a good deal of rotation of the hand, and the uncut tissues prevent it; it will suffice if it rests fairly on the staff. The surgeon, keeping his eye on the latter, will slip the knife along the back of the finger and will easily find the groove; if there is any difficulty, the knife is not to be at once carried deeper, but its point should be moved laterally, without cutting, when it will probably be found to touch the staff on one side or other, and the groove will be quickly entered. This being done, the staff is raised into the perpendicular position and hooked firmly up against the pubic arch, as before mentioned, the knife following it, and then being pushed cautiously along quite to the end of the groove in the bladder. Young operators sometimes find this a little awkward; they are so strongly cautioned against allowing the knife to leave the staff that they direct it upwards, and its point, impinging against the metal, will not readily glide along; it is only necessary to raise the hand a little to make it slip forwards. The beginner should practise this before operating, and the proper adaptation of the knife and staff will soon be acquired.

The next step is one of delicacy and importance. It is useless to withdraw the knife in the same line as it entered, unless the stone is very small; some division of the prostate and neck of the bladder is necessary, and it is now to be made by a draw-cut. The knife, with its edge well lateralised, is to be pressed gently but steadily downwards and outwards as it is withdrawn, the pressure diminishing by degrees to nothing as the external wound is reached. Only experience can guide one aright at this stage. Those who prefer a free incision, with its risks of hæmorrhage and extravasation of blood or urine, will use more pressure; and those who prefer a small incision, with the certainty of laceration, will use less: the safe course is the medium one.

The left index finger is now passed along the groove into the bladder, and the staff is withdrawn. The depth of the bladder, the size and position of the stone, and the extent of the deeper part of the wound are ascertained. The finger is to be used to dilate the neck of the bladder in all directions, employing pretty strong pressure in doing it, and so making a smooth path for the entry of the forceps and for the further dilatation of the vesical orifice. Martineau and Liston laid great stress on this dilatation by the finger. Having ascertained the size of the stone, the surgeon selects the forceps, taking care not to fall into the mistake of using too small a pair; he passes them along the upper or dorsal surface of the finger, withdrawing the latter as the forceps enter. The blades should be fully introduced before opening them—this is done slowly and in a lateral direction—then, by giving a quarter turn to the handles, one blade is made to sweep round to the lower fundus of the bladder, and by this manœuvre the stone will almost certainly be caught. If it is not, the process will be repeated, and, if there is still a difficulty, the surgeon will ascertain if he has not passed over the stone, which is not infrequently found close behind the prostate and beneath the forceps; if this be so, he will withdraw them slightly, elevate the handles, and repeat the rotatory movement. Sometimes, though rarely, the stone is entangled or held by irregular contraction of the bladder at the upper fundus, in which case the handles should be lowered and the blades directed upwards, while an assistant makes firm pressure above the pubes. The large size of the stone sometimes makes it difficult to grasp it; in this case the operator will withdraw the forceps, perhaps take a larger pair, and having ascertained with his finger the exact position of the stone, he will introduce them so that the tips of the blades impinge on it; then by slowly opening them they will be found to glide over each side of the stone, and a good hold is obtained.

All these manœuvres are to be slowly and gently conducted, and there should be no wild 'digs' at the stone or sudden alterations of method. The extraction should be deliberate and steady, the direction somewhat downwards, the blades and handles of the forceps kept in a vertical position, and no rotation made as the stone advances, for fear of injuring the prostate and neck of the bladder. Should there be much resistance and no sense of gradual yielding, the surgeon will ask himself the question whether this is due to an insufficient opening, or to the projection of the ends of an oval stone laterally beyond the blades. This latter may be known by observing that the bladder is brought bodily down, so that the prostate, which is probably large, is visible near the external wound; in this case, the stone must be liberated, the finger again introduced, and a fresh hold taken. If the obstruction is due to a large stone and too small a wound, the latter is to be enlarged in the direction of the first incision; this, in the opinion of the writer, is preferable to making a division of the neck of the bladder on the opposite side, and preferable, too, to using undue traction force. The stone being removed, the bladder is again fully examined with the finger, and if necessary with a searcher, to see if another calculus or piece of one remains; any bleeding vessels are to be tied, or the wound plugged, as will presently be described. The silver tube is introduced and secured by tapes and a bandage round the body, a morphia suppository put into the rectum, and the patient placed in bed with hot bottles to his feet.

The after-treatment is very simple. The bed should be a firm hair-mattress, protected by a waterproof, and plenty of old sheets cut into squares for frequent removal; a rope and cross-bar should be arranged above, so that with his hands the patient can raise his hips without undue exertion. His knees are to be supported by separate pillows, with an interval between them, so that the light is not obstructed and the tube can easily be got at. This must be kept free, by a feather or a small sponge on a wire, so that the urine shall easily pass, and clots be removed if necessary. The secretion of urine is often scanty for the first twelve or twenty-four hours, and then it flows freely; if it ceases, and the patient is in pain, the tube should be gently pushed a little further in, or a flexible catheter may be passed through it into the bladder. In ordinary cases the tube may be withdrawn in thirty-six hours, but if the prostate is large or if the patient had been compelled to use the catheter previously, it will be right to retain it three or four days or more; and even then it will, in the cases just mentioned, be requisite for the nurse or surgeon to draw off the urine by passing a catheter through the wound as often as may be necessary, until its use by the urethra is resumed. If the urine is alkaline and acrid, the skin of the perineum and nates is apt to be excoriated, especially in the aged and feeble; and this is to be guarded against by frequent washing and change of bed linen, and by the free application of zinc ointment. In these cases, much benefit will accrue from washing out the bladder with Condy and water or boracic water, twice or thrice daily; the deposit of phosphates, which coats the surface of the wound and may lead even to phosphatic concretion and recurrent stone, is thereby lessened, and the cystitis is greatly alleviated. The diet should be simple and good; a mild aperient may be taken on the third day, and, if requisite, it should be aided by a simple enema. The urine generally begins to flow by the urethra between the end of the first and second week, depending somewhat on the size of the stone and the condition of the patient; and the external wound is generally healed, and the cure complete, within the month.

The Obstacles met with in lithotomy are chiefly due to—1, the large size of the stone; 2, enlarged prostate; 3, breakage of the stone; 4, encysted stone. (1) The mode of dealing with large stones has already been briefly described. In these days of anæsthetics, stones of such magnitude as are described in the *Medico-Chirurgical Transactions*, vol. xi., are not likely to be met with. The largest in the Norwich Hospital weighed nearly thirteen ounces, and the surgeon failed to extract it. There is, however, a stone in the hospital museum which weighed nearly fifteen ounces; it was successfully removed by Mr. Harmer in 1746, assisted by Benjamin Gooch, who, in describing the operation, says: 'I divided the parts occasionally as he continued to make a gentle extraction.' This sentence describes pithily the best mode of removing stones of large size; it means practically a judicious combination of dilatation and cutting, and probably some rupture of tissues. It is far better than attempting to break a hard compact stone, by which serious injury to and sloughing of the soft parts are likely to be produced. In the present day, however, it is probable that stones weighing upwards of three ounces will be dealt with by the improved method of supra-pubic lithotomy.

(2) Enlarged prostate, undoubtedly, is sometimes a serious obstacle in lithotomy, and if it is combined with a full-sized stone the difficulty is very considerable. The bladder is probably beyond reach, and the size and position of the stone cannot be accurately known. Still, the finger will reach well into the prostatic urethra; the knife has already made a free incision, and the forceps will readily pass in. It is in the extraction that the trouble lies; the rigid prostate will not easily dilate, and if the stone is of any magnitude, there is certain to be some yielding of tissue. This rupture always takes place below, at the thinnest part, so that, when the wound is examined after the extraction of the stone, the gland seems to be, and indeed is, separated into two lateral lobes. If the median portion projects prominently into the bladder, it may get entangled in the forceps and be torn off, or a fibrous tumour in one or other lobe may be forced out by the stone as it passes. This accident has been deemed by some surgeons as of no disadvantage, but it is probable that a careful examination of the subsequent condition of such patients would show that, although it may not have endangered life, it has not infrequently been followed by partial inability to retain urine.

(3) The breaking of the stone in the forceps has two disadvantages: it makes the repeated use of instruments necessary, and, what is of more importance, it entails the risk of leaving a fragment behind. The same may be said when there are a number of small stones. Nothing requires more deliberate care and perseverance on the part of the surgeon than the entire clearance of the bladder under these circumstances: small fragments, or small stones, are apt to be surrounded by clots or viscid mucus, or to get into the recesses of the mucous membrane, and are not easily detected by the searcher or even by the finger. Frequent syringing with a Higginson's enema and a small flexible tube, so as to search every part of the bladder and allow of a free return stream, and the careful exploration with the sound and finger, are all that can be done; but the case should be narrowly watched after the operation, and if, within two or three weeks, the patient should complain of pain when the bladder contracts, a sound should be used. If a small piece of stone is detected, an attempt may be made to extract it by means of long slender forceps through the wound; or the latter may be dilated with the finger, and forceps of adequate size used; or, what perhaps is a better plan, the wound may be allowed almost to heal, and a lithotrite be applied to complete the cure. Recurrence of stone within two years almost always means that a fragment has been left after the operation. No greater disappointment than this, both to the surgeon and the patient, can happen. No one, probably, has cut fifty patients without having to admit and lament its occurrence, but it is especially liable to occur to the inexperienced.

(4) The stone may be encysted, and this constitutes a very dangerous and puzzling obstacle. Fortunately it is rare, but the writer has met with at least six or eight instances. Each case will present peculiar features; no rule for general adoption can be laid down, and the surgeon must decide, at the moment, how to attempt to remove the stone, and how far to persist in such attempts and when to desist. Sometimes, one or more stones are lying free in the bladder and can be easily removed, and then the finger, in making a thorough exploration,

feels the point of one that is hidden in a sac or cyst. Possibly, the surgeon may succeed in dilating the mouth of the sac with his finger, and possibly, also, he may be able with forceps or, more likely, with a long narrow scoop curved almost to a right angle, to dislodge and remove it. This manœuvre will only occasionally succeed, however, and it will be prudent to leave the stone embedded, in which case all that can be done will be to remove, with the lithotrite, from time to time projecting masses of phosphates, which are sure to grow up into the cavity of the bladder. In this way the patient's comfort may be promoted for a time, but ultimately he will sink from cystitis.

The Dangers of Lithotomy are—1, hæmorrhage; 2, wound of the rectum; 3, perforation of the bladder. (1) Hæmorrhage is either primary or secondary; that which comes from the transverse artery of the perineum or any other, in the first incisions, may be disregarded at the moment; it generally ceases as the further steps of the operation proceed, and the vessel can be tied when it is concluded. The artery of the bulb should not be cut, but it frequently is, especially by beginners, who are naturally anxious to reach the staff, and who make their incisions too far forward; it is not easy to place a ligature on it, but pressure-forceps will control it, and may be left on for a day or two. Deeper sources of arterial hæmorrhage, and that which comes from enlarged hæmorrhoidal or prostatic veins, must be dealt with by the plug, either the air-tampon of Buckston Browne fully introduced and moderately distended, or by long strips of dry lint pushed with a blunt instrument deeply all round the silver tube. The end of each piece is left hanging from the wound, and so placed and noted that, when the time comes for removing the plug, the last piece which was put in may be the first withdrawn. The wound, however, should be plugged with reluctance, it is always an evil; it offers some obstacle to the free escape of urine and serous discharge, leads to ecchymosis around the base of the bladder and in the pelvic cellular tissue, and presses, sometimes injuriously, on the neighbouring soft parts. Before resorting to it, ice may be applied to the perineum and cold water injected into the bladder, and the case watched for a short time. Should, however, the loss of blood continue actively, and particularly if it should recommence after an hour or two, when the patient is warm in bed with reaction fully established, and if it be accompanied by vesical tenesmus and the forcible expulsion of clots, the case must be resolutely dealt with at once. The patient should be brought to the edge of the bed in a good light, the tube removed and cleansed, the finger introduced into the bladder and coagula removed as far as possible; and then the tube is to be replaced and a fresh plug or tampon introduced. Secondary hæmorrhage is a much more serious danger; it may come on in three or four days from the softening of restraining clots, or in one or two weeks from the separation of sloughs. It sometimes occurs without pain or the knowledge of the patient; sometimes, it begins with a rigor and the expulsion of coagula, with straining. At first, ice-bags to the perineum and above the pubes, or the injection of cold water, may be tried; but if the bleeding recurs to a serious amount, the re-insertion of the tube and plug, thoroughly and firmly applied, is chiefly to be depended on. Happily, it is very rare to meet with a death from hæmorrhage, however near to it apparently the patient may be brought.

(2) Wound of the rectum may occur in various ways. Above the internal sphincter the ampulla of the bowel approaches very near to the membranous urethra, and it may easily be injured if the knife is not sufficiently lateralised while making the deeper incisions; or sloughing may follow the extraction of a large stone some time after the operation. In any case it will be right to do nothing for a time; nature is often competent to bring about a complete cure as the healing goes on. If not, the perineal wound may close and a recto-urethral fistula will remain, and, so remaining, a slight exchange of the fluid contents of either canal may take place with but little attending inconvenience. Should the perineal wound not heal, and there is a free communication with the bowel close above the sphincter, the latter should be divided; but this will seldom be required. Caustics or Paquelin's cautery carefully used will lead to contraction, and time will aid much.

The perineal wound may be slow to heal, either through injury done by the forcible extraction of a large stone, or through the feeble condition of the patient leading to the deposit of phosphatic matter on the entire surface of the wound. By degrees this coating comes away, but it sometimes happens that little cavities may be formed in or near the prostate, and so the complete and firm healing of the wound is delayed. It may even happen that some particles of this phosphatic covering may pass into the bladder or remain in the prostate, and so give rise to future trouble and recurring stone. This condition of things should be carefully watched; frequent syringing through the wound with boracic or acidulated water early in the case will tend to obviate it, and remove the incrustation and prevent the consequences named. The insertion of probes coated with nitrate of silver or the wire cautery will expedite the healing of a clean sinus, but, here again, time and the restoration of the patient's strength are important aids to full recovery.

(3) Perforation of the bladder is an accident which can rarely happen. It may occur in a contracted bladder with a staff having too long a curve and too pointed an end, and especially if the surgeon, taking the staff in his left hand, pulls it somewhat towards himself as some surgeons do who use the gorget; the knife can never injure the bladder if its point is carefully kept within the groove. The accident is probably not suspected at the time, but rapid and overwhelming peritonitis quickly sets in, and the misfortune is only discovered at the autopsy.

The Causes of Death after Lithotomy are various—shock and exhaustion; suppression of urine and kidney disease; phlebitis and pyæmia; and extravasation of urine. The last was considered, by the older surgeons, to be by far the most frequent of the fatal effects of lithotomy. At the present time this is by no means admitted to be the case; it is probable that, with the advance of pathological knowledge, the causes of death which used to be attributed to infiltration of urine are now recognised to be due to other conditions. When it does occur it may be looked for about the third or fourth day or later; it is often insidious in its approach; there may or may not be a rigor, little or no pain, probably some tenderness of the lower abdomen; dry tongue, fever, anorexia, hiccup, exhaustion, and death. Sometimes it is accompanied by tympanitic distension and peritonitis, and sometimes, too, its progress is milder and the condition ends, not necessarily in death, but in pelvic abscess, which may find an escape through the wound or bowel, or be reached by incision of the abdominal wall. The treatment of these various conditions is not materially modified by their connection with lithotomy, and need not be specially described here.

LITHOTOMY IN CHILDREN is modified by the anatomical conditions that the bladder is situated high in the pelvis, the prostate is wholly undeveloped, and the urethra very small; this last fact alone constitutes the chief difficulty and risk of failure. The incisions, although they will properly be made more freely in proportion than in the adult, must still be limited, and the attempt to pass the finger along the staff—which already fills the urethra—is fraught with the risk of separating the bladder from its anterior connections, pushing it back away from the staff, and failing to reach it altogether. In a young child, the least force used at this stage of the operation will end in this failure, and gorgets, dilators, and other contrivances have been designed to obviate the difficulty; but these instruments themselves require very careful handling, and have sometimes, in the hands of inexperienced operators, led to disaster. The writer has never used them, but has proceeded in one or other of the following ways:—The staff being exposed and the resistance to the finger recognised, the surgeon will consider the position, and, if he has the least doubt as to the sufficiency of his incision, he will again use the scalpel or a probe-ended bistoury and extend it, and again try his finger; should its passage be still resisted, he may introduce easily a pair of ordinary polypus-forceps along the groove, and dilate the neck of the bladder by opening the blades; he may even carefully seize and remove the stone with them, or, having stretched the parts open, he may introduce his finger and the lithotomy-forceps or scoop in the usual manner. Another method the writer has frequently adopted is this: when the staff is well exposed and the deep incision made, the tip of the left forefinger is placed on it, but no attempt is made to pass it into the bladder until the staff is withdrawn; then the finger is gently wormed along the empty urethra, dilating it as it goes. With an empty urethra and a proper incision, he has never met with any real obstacle to the passage of the finger; there is no other route open to it, and it is only a question of sufficient or insufficient room. But here, as always, the golden rule of avoiding undue force must be remembered, and, if resistance is met with, the staff should be reintroduced and the knife again applied. With this exception, the other steps in the operation in children are similar to and more easily carried out than in the adult. Urinary infiltration is so little to be dreaded in children that it is not necessary to use a tube; moreover, it is difficult to restrain the sudden movements of a child during sleep or even when awake, and on this account a tube is objectionable.

MEDIAN LITHOTOMY is performed as follows:—The staff, of moderate size with a central wide groove, is held as in the lateral operation, with its handle inclined towards the umbilicus. The left forefinger is passed into the rectum, with its tip resting against the apex of the prostate. Keeping it steadily there as a guide to the membranous urethra, a long narrow bistoury, double-edged near its point, is passed, with its back towards the bowel, through the raphé of the perineum straight into the staff. Having reached the groove, and the handle of the staff being replaced in the perpendicular position and hooked well up against the arch of the pubes, the knife is pushed slightly towards the bladder so as just to nick the apex of the prostate; then a forward cut is made along the groove for nearly an inch, in order to divide the membranous urethra, and as the bistoury is removed a draw-cut upwards is carried through the central line of the perineum to the requisite extent. The operation is then completed as in lateral lithotomy. Some operators prefer to reach the staff by dissecting down to it; but the plan advocated above is simpler, and is perhaps less likely to wound either the bulb or the rectum.

The advantages of the median over the lateral operation are: the somewhat smaller amount of cutting, the rapid recovery in favourable cases, and the slight injury done to the neck of the bladder, but these advantages are only obtained when the stone is small; when it is large the difficulty of extraction is considerable, and laceration of tissue is unavoidable. The disadvantages are: the liability to wound the bowel, which lies in immediate and dangerous proximity to the wound; the frequent occurrence of troublesome bleeding, which can only be arrested by the tampon or the plug, and the general want of room and space for dealing with stones of some magnitude. It is true that the writer has removed a stone by this method which weighed nearly five ounces, but he believes that, with the lateral operation, the manipulation would have been easier and the recovery of the patient quicker. Some years ago, the surgeons of the Norwich Hospital gave median lithotomy a fair and extensive trial, the writer alone having had upwards of fifty cases, and the result was that he and his colleagues have all but relinquished it both for children and for adults. The advantages seemed to them to be on the whole less than the disadvantages, and the results were not more favourable than in the lateral operation, if so good. It is suitable only for small stones, and these, for the most part, are best dealt with by lithotrity.

SUPRA-PUBIC LITHOTOMY, since its first introduction by Peter Franco in 1541, has experienced many vicissitudes. In its first century it awakened great hopes of success, which, however, owing to repeated failures gradually faded away, and it fell into disrepute until about the beginning of the last century, when it was revived and adopted amongst others by Cheselden, who practised it with such success that surprise may be felt that he ever relinquished it. He was, however, induced to do so, not by any dissatisfaction with it, but by the hope of even greater success from the adoption and modification of the perineal operation of Raw. The lateral method, when it became stamped by the sanction and success of Cheselden, took its place firmly, and again the high operation became obsolete. During the last thirty years it has been practised some forty or fifty times in America, as may be seen in a good paper on the whole subject by Dulles in the *American Journal of Medical Sciences*, July 1875; but its success was not sufficient to recommend it to English surgeons, who have been content to adopt it, unwillingly, only in cases of unusually large stones.

In 1880, however, a fresh impulse was given by the improved method of operating suggested by Professor Petersen of Kiel. He noticed the effect of fully distending the rectum in causing the bladder to project above the pubes, so as to bring it within easy reach and to remove the anterior fold of the peritoneum well above the risk of injury by an incision. This indeed was fully demonstrated by Dr. Garson in a paper published in the *Edin. Med. Journ.* for October 1878. He distended the rectum by introducing a rubber bag and filling it with water. The bladder having been also distended, the body was frozen, and a vertical section of the pelvis made and accurate observations and measurements taken. These observations made by Garson, when under Professor Braune of Leipsic, may be said to have laid the foundation of the present mode of conducting the high operation.

Operation.—The patient rests on his back near the end of the table, with the knees elevated and separated. The surgeon first introduces a catheter, washes out the bladder with boracic water, and fills it slowly and carefully with the same as full as it can easily bear. The catheter is withdrawn and the water retained by a ligature on the penis. The india-rubber bottle is next introduced into the rectum. This bottle is made of thin rubber; it is pear-shaped, with a long tube at one end through which to fill it. It is introduced empty by folding it longitudinally and dipping it into carbolic oil. Warm water is slowly injected by a common enema syringe through the long tube. The water is contained in a pint-glass graduated measure, so that the exact quantity used can be watched; this is a matter of some moment, for, if an excessive quantity be introduced, there will be risk of rupturing the coats of the rectum. Petersen says as much as 21 oz. (avoir.) may be used; but this would probably be seldom required, and from 12 to 16 oz. will be found sufficient. The writer in one case used 18 oz., and it was noticed that when, after the stone had been removed, the bag was emptied and withdrawn, a teaspoonful of blood escaped. The patient died of kidney disease and suppression of urine, and it was found, on post-mortem examination, that the mucous membrane, and even the circular muscular fibres, of the bowel had been ruptured at the upper or bladder side, and that there was some ecchymosis and sloughy tissue around the injured part.

The patient's legs are now lowered, and an incision about three inches long is made in the median line, the lower end of which comes well over the upper border of the symphysis pubis. The operator works his way between the recti and pyramidales muscles, nicking them on each side if necessary, until he comes to the loose fat which covers the bladder wall; this is scratched through by the finger-nail or handle of the knife. The peritoneum will probably not be seen, for the fold of it will be an inch or two above the knife. The bladder being exposed, a tenaculum or hook is used to steady it, and the knife is dipped into it on a level with the upper border of the pubes, and the wound is extended a little upwards and downwards. The water immediately gushes out, and the stone is felt with the finger close at hand. In some cases, when it is small, it can be removed with the finger alone or aided by a scoop; but with large stones, for which alone English surgeons are likely to resort to the high operation, forceps of adequate size must be used. The edges of the bladder-wound may require to be held up and steadied by delicate hooks, during this manipulation. Extraction should be slow, and very little force used, for it is better to extend the incision upwards rather than bruise the wound by over-stretching. The wall of the bladder is apt to bleed rather freely, but it soon ceases, and any little vessel may be secured by ligature if necessary. A full-sized, long drainage-tube is passed fully into the bladder, and secured by a thread to the margin of the external wound. The upper part of the bladder wound is closed by two or three fine catgut or silk sutures : the upper part of the external wound, too, may be closed, the lower part being left open for the escape of blood or other fluid. Oiled lint and absorbent bags are secured around the tube, and the patient is placed in bed on his side, with the free end of the tube in a basin by the side of the bed. When this position becomes irksome, he may turn on the other side, care being taken that the tube is properly placed and the dressings not disturbed.

Some surgeons recommend that, in addition to the tube, a catheter should be retained in the bladder through the urethra; others that no tube should be used, but the aperture in the bladder wholly closed and the bladder drained, either by a catheter tied in, or by a tube introduced through a perineal opening. On this point, and in several details of the operation, further experience is wanted for trustworthy guidance. So also, it is too early to speak of results. Petersen, and Guyon of Paris, have had fair success, but the number of cases is at present too small to admit of comparison with lateral lithotomy. The chief danger to be apprehended is from extravasation of urine behind the pubes, in the loose cellulo-adipose tissue around the bladder. Peritonitis, which used to be the too frequent result of the high operation, was due to direct wound of the peritoneum; now, however, this can scarcely happen, and peritonitis will only occur as a secondary consequence of urinary extravasation. From shock, from hæmorrhage, from possible impotence, from wounds of the rectum and perineal fistula, which are the occasional results of perineal lithotomy, the supra-pubic method will be free. The operation is easy to do, and unless it turns out to have a heavy mortality, it is almost certain to take a high place in professional esteem, and to supplant all other methods for the removal of large stones.

LITHOTOMY IN THE FEMALE, whether adult or child, is still surrounded by several undecided questions. Stones, of small or even of moderate size, may safely be removed by dilating the urethra with the three-branched screw instrument so as to admit one or two fingers; this is followed by small lithotomy-forceps, and the stone is slowly extracted. Some laceration of the mucous membrane of the urethra is almost sure to occur, but the result of this proceeding is most satisfactory; the patient will experience no incontinence of urine or other ill-effect, and will probably be convalescent in a few days. But when the stone is of considerable magnitude, the surgeon has a choice of several methods of removal. He may adopt lithotrity with immediate removal of fragments by Bigelow's plan, if the stone is not larger than a strong ordinary lithotrite can deal with, say up to an ounce and a half or two ounces. In favour of this proceeding is the fact, that the largest evacuating tube may be readily used with a little dilatation. Or the stone may be broken and removed piecemeal by small forceps: or he may make an incision upwards laterally on a grooved staff, dilate the neck of the bladder with his finger, and extract the stone entire.

Should the stone be still larger, say three ounces or more, the choice will lie between vaginal and supra-pubic incision. The former is certainly to be preferred to any plan of cutting the urethra, whether upwards or laterally, and dragging the stone through that passage; such a proceeding would almost certainly, with a stone of considerable size, lead to permanent incontinence and future misery; but it must be admitted that a vaginal incision, combined with the force necessary to extract a large stone, may lead either to permanent vesico-vaginal fistula or to the necessity of repeated operations for its closure. The supra-pubic operation conducted after Petersen's method offers the most tempting inducement; it is not difficult of execution, it entails no liability to incontinence, and the free drainage of the bladder by the urethra is easy. The one cause for hesitation is the possible risk to life from peritonitis or urinary infiltration which this operation may entail, and this risk there are, at present, no means of accurately estimating. Experience alone can decide the question. In children, however, when the stone is full-sized, the supra-pubic operation should surely be preferred; the small and undeveloped urethra and vagina, the abdominal position of the bladder in the young, and the comparative immunity of children from urinary infiltration, are considerations which may well lead to its adoption.

It should be borne in mind that, in young women, the presence of stone in the bladder is generally due to incrustation on some foreign body introduced by the patient, and this may produce some difficulty in, and require some special method for, its removal. Another point connected with stone in the female may be mentioned—viz. the spontaneous expulsion of even large calculi from the bladder. This has been quoted to prove how dilatable the urethra must be (*see* paper by Bryant, *Medico-Chir. Trans.*, vol. xlvii. p. 151). In the Norwich Hospital Museum is a large stone which dropped from a woman without any operation or effort on her part: it weighed six ounces. There is no history of the case, but there is reason to believe that in this, and in some of the instances given by Mr. Bryant, there was first a prolapse of the vesical wall into the vagina, then the continued straining efforts of the bladder increased the prolapse, and that, finally, ulceration and liberation of the stone took place. The writer saw one such case many years ago, in which a full-sized stone had caused such a falling of the bladder and upper wall of the vagina that it presented as a round mass at the os externum, and had been mistaken for prolapsus uteri.

The Results of Lithotomy may and should be regarded from two points of view—1, the mortality; 2, the tendency to recurrence of stone.

(1) *Mortality after Lithotomy.*—The value of mere statistics is small, but they may justify approximate estimates on some points which will serve for guidance in practice. Those of the Norwich Hospital only will be used, partly because they consist of a compact body of cases of large number and done on some uniform system; and also because there exists in the hospital museum, not only a record of the chief facts of every case of lithotomy and lithotrity from the commencement of the hospital up to the end of 1884, just a hundred years, but the calculi also are there, cut and labelled, and well displayed to prove the accuracy of the record.

The whole number of operations amounts to 1,245. Of these, 1,124 were by lithotomy and 121 by lithotrity.

Of the 1,124 lithotomy cases, 1,074 were males and 50 were females.

Of the 1,074 males, 927 recovered and 147 died, being about 1 in $7\frac{1}{3}$, or $13\frac{1}{3}$ per cent. Of the 50 females, 46 recovered and 4 died, being about 1 in 12, or 8 per cent.

Age, of course, influenced greatly the results. Thus, there were 513 cases under twenty, of which 475 recovered and 38 died, being about 1 in 14, or 8 per cent.; and 562 were over twenty, of which 456 recovered and 106 died, being 1 in 5·3, or about 19 per cent.

Of the adult males it may be further said, there were 465 over forty, of whom 349 recovered and 116 died, being 1 in 4, or 25 per cent.; while there were 169 over fifty, of whom 123 recovered and 46 died, being 1 in 3·67, or 27·4 per cent.

Weight of stone, again, affected results; thus, there were 794 cases in which the weight was 1 oz. and under, of which 723 recovered and 71 died, being 1 in 11·2, or 9 per cent.; of 1 oz. to 2 oz., 193, of which 159 recovered and 34 died, being 1 in 5·6, or 17·6 per cent.; of 2 oz. to 3 oz., 55, of which 35 recovered and 20 died; of 3 oz. to 4 oz., 14, of which 5 recovered and 9 died; of 4 oz. to 5 oz., 9, of which 6 recovered and 3 died; of 5 oz. to 6 oz., 3, of which 1 recovered and 2 died; of 6 oz. to 7 oz., 2, of which both died; of 7 oz. to 8 oz., 2, of which 1 recovered and 1 died.

Of the 151 fatal cases, males and females, the average age was forty-six, and the average weight of stone 840 grains. Of the 151 cases, 38 were under twenty, with an average weight of stone of 424 grains, and 113 were over twenty, with an average weight of stone of 1,122 grains, or 2½ oz.

(2) *Recurrence of Stone after Lithotomy* is comparatively rare. During the century of work at the Norwich Hospital, and out of about 1,030 individuals who were cut, only 40 were operated on a second time, and 5 a third time. It may be said that 150 of this number died, and could not, therefore, have had recurrence, and that many who had once experienced the agony of lithotomy would not have had courage enough to face it again; this would, however, only apply to pre-anæsthetic times, whereas since the use of ether recurrence is still rare. The causes of recurrence are (1) the descent of a fresh renal stone, and (2) the leaving of stones or fragments of stones at the first operation. A careful examination in the museum shows that, of the 45 individuals who had recurrence, in 21 the stone was broken at the operation, and in 14 there were multiple stones; and, further, that the interval between the first and second operation was far less in these 35 cases of multiple or broken stone than in the other 10 cases, where only one unbroken stone was removed. The inference is strong, almost amounting to proof, that, in a large majority of instances, recurrence of stone after lithotomy is due to stones or portions of stone having been left at the first operation.

William Cadge.

LITHOTRITY.—Since the first introduction of lithotrity sixty years ago, its progress and development have been steady and continuous. Civiale and Leroy-d'Etiolles in France, and Brodie in England, were mainly instrumental in establishing it as the proper rule of practice for stones of moderate size. Brodie's article in the *Medico-Chirurgical Trans.*, vol. xxxviii., is a model of lucid treatment of the whole subject; in it he reports the results of upwards of a hundred cases, setting forth with admirable candour his failures even more prominently than his successes; indeed, his clear exposition has left but little for his followers to do, except in the way of slight modifications of instruments and details of procedure. In both these particulars, however, improvement has gone on, and it has been illustrated in the work and writings of the Coulsons, and especially of Sir H. Thompson, whose name and fame are bound up with recent lithotrity. Five years ago it seemed as if, both as to its principles and method, the operation might be considered almost perfect; but in 1878 Professor Bigelow, of Harvard University, recognising the importance of the full dilatability of the urethra as demonstrated by Otis, and recognising, too, the value of Sir P. Crampton's and Clover's plans of extracting calculous débris from the bladder by suction, applied these observations to lithotrity, with the result that in his hands the operation has taken a new departure, based on principles wholly different from those which all surgeons up to that time had advised and adopted.

Thus, the old rules of practice were: repeated short sittings, the smallest possible use of instruments, and leaving the extrusion of débris as much as practicable to nature. Bigelow, on the other hand, maintains that the bladder is less hurt by the prolonged use of smooth metallic instruments than by the presence of sharp, angular fragments of stone; he therefore removes the entire calculus at one long sitting, even of one, two, or three hours' duration, if necessary, by suction through a large evacuating tube. He, aided by Otis, Keyes, Van Buren, and others in the United States, has proved the value and correctness of these principles by successful practice; he has demonstrated the method of operating in Europe, and after a short period of hesitating and somewhat reluctant assent, the plan has been almost universally adopted, and the old mode by repeated sittings is becoming obsolete. 'Litholapaxy,' as the new method is termed, has been applied to larger and larger stones, and its capability in this direction is not yet determined.

The instruments required are: (1) lithotrites of various sizes; (2) evacuating tubes; (3) an aspirator. Lithotrites are of two kinds, fenestrated and non-fenestrated. The female blade of the former should be somewhat flattened, and the prehensile surface slightly grooved or roughened, so as to hold the stone when seized. The male blade should be serrated and fit accurately. In the non-fenestrated instrument the female blade should also have its edges roughened, and there should be an opening in it for the lower half of its length, into which a projection on the male blade will fit. The object of this is to diminish the risk of over-impaction, but it will not prevent it altogether, for the upper half of the female blade may be over-packed with débris, and there are no means of freeing that part. Still, it is at the heel or junction of the blade and shaft that impaction is most likely to occur, and the larger opening mentioned will to a certain extent prevent it. The male blade should be serrated, wedge-shaped, and of less width than the female blade, so that the mucous membrane may not be easily caught. The handles of all lithotrites should be cylindrical or hexagonal in shape, with a sliding button to put the screw into immediate action. Sometimes the screw will not easily adapt itself, but will catch on the edge of the worm; this, however, is obviated by giving a slight turn to the ring on the male blade, when the screw will slip home and adapt itself instantly.

The evacuating catheters or tubes are slightly curved or straight: the curved are easiest to introduce, the straight are the best evacuators. Bigelow prefers the straight ones, and Otis has suggested that the extreme end beyond the aperture should be slightly turned up, so as to facilitate its passage. These tubes are usually made in three sizes, equal to 14, 16, and 18 English scale. Each should be fitted with a gum-elastic bougie, which passes the whole length of the tube and partially fills up the lower aperture, thus rendering its journey to the bladder easier, and serving also to clear it of impacted fragments when necessary. Aspirators, made of stout india-rubber, are of various shapes; they all have a funnel and stopcock at the top. Some have a glass trap or receiver at the lower end, into which the fragments fall, and the evacuating tube fits into the centre of the bottle; in others, the glass receiver is separate from the bottle and intermediately placed between it and the evacuator. The latter is provided with a hanging wire valve, which is necessary to prevent the regurgitation of débris into the bladder. The evacuator is connected with the receiver or aspirator by a short tube fitted with a stopcock, or simply by a piece of rubber tube three or four inches long, which has the advantage, by its flexibility, of preventing any disturbance of the catheter in the bladder by slight movements of the aspirator. Bigelow has contrived a frame to sustain the apparatus and stand on the bed, and Otis has lately introduced an aspirator, by which the water is forced into the bladder by air-pressure from a separate rubber bottle. It is probable that, as time goes on, other modifications and improvements will be made; at present none of the aspirators are perfect.

Before proceeding to the operation, it is important to ascertain, as far as possible, that the patient is in the most favourable condition; that by rest and careful preparation the whole urinary tract and organs are in a quiet and satisfactory state. It is not necessary or desirable to accustom the urethra to the repeated passage of instruments. A clear estimate of the size and nature of the stone and of the prostate will have been ascertained by the sound, or possibly by the lithotrite. Also, the surgeon will have informed himself of the kind of bladder he has to deal with, as to its irritability, its capacity, its shape, hardness, or roughness, and any feature of peculiarity about it. It is not necessary at the time of operation to inject water into the bladder, as used to be done; but it is well that there should be some urine in it, say the secretion of an hour or two, or as much as can comfortably be borne. The patient should lie on a firm mattress with a cushion beneath the buttocks, and the head low; the knees slightly raised, well separated, and each leg steadied by a nurse or assistant; the chest, body, and limbs should be well covered with blankets, so as to prevent exposure to chill during a proceeding which may be long. An anæsthetic is absolutely necessary in one-sitting lithotrity: in all cases it facilitates the use and manipulation of instruments, and especially in the deliberate and careful search for final fragments.

Operation.—The surgeon, standing on the patient's right side so close that he has not to reach or stoop much, and with his instruments within easy reach, insinuates the lithotrite along the urethra; it matters little how this is done, so far as the penile portion is concerned. Generally the instrument should be parallel with one groin or the abdomen; but when the triangular ligament is reached the hand must be raised to the perpendicular, and the point of the blades coaxed through this part by a manœuvre, difficult to describe in words and not always easy to execute. If any hesitation should occur, no force is to be applied, and it is useless to lower the handle prematurely as if the prostate had been reached; rather, the hand should be dropped towards the abdomen, and fresh gentle attempts made, varying the direction slightly. When this point is passed, the handle is gradually lowered towards the bed, and the instrument will slip on into the bladder almost by its own weight. If the prostate is enlarged, some little pressure and a very slight rotatory movement of the lithotrite may be required to carry it on, and the handle still further lowered so as to lift the blades over any obstacle at the vesical orifice.

When fairly in the bladder, the handle of the lithotrite should be somewhat raised, and the blades made to depress slightly the lower and back part of the bladder, and opened fully. By this simple manœuvre the stone will generally fall towards the instrument, and will be caught when the male blade is pushed down, care being taken not to raise the female blade out of its position. If the stone be not seized, the instrument may be turned to one or other side, or it may be wholly reversed and the stone picked out from behind the prostate. In doing this, care is required to avoid pinching the mucous membrane, and the closing of the blades should be slow and gentle. It is not always easy to distinguish between a piece of soft stone, enveloped in concrete mucus, and the lining membrane of the bladder. In this and in any case, before applying pressure either with the hand or screw, the blades with the stone should be turned up into the centre of the bladder. When once the stone is fairly seized and broken, the operator will have little difficulty in rapidly picking up pieces, and he should endeavour to attack the larger ones so as in a short time to produce good fragmentation.

This being done, the evacuating tube is substituted for the lithotrite, the same precautions in its introduction being required as for the lithotrite. If the stone is of small or moderate size, No. 14 or 16 tube will suffice, but if it be large, No. 18 possesses great advantages in the rapidity of removing débris. It is not necessary at each pressure of the aspirator to introduce much water; short and quick strokes give the best results. If the rubber bottle will not expand readily, a fragment of stone or clot of blood is probably impacted, and may be returned to the bladder by a sharp pressure of the bottle, or, if necessary, by disconnecting it, and freeing the tube by the gum-elastic plug. Sometimes, while the aspirator is extracting the water, the bladder may be felt to strike the end of the catheter with a vibratile thud. This should not be; it is a sign that the bladder is too empty; it is apt to be injured in its lining membrane, and it interferes with the free escape of detritus. It is easy to introduce a little more water, and then proceed. Care should be taken, when the instruments are changed, to leave four or five ounces of water, and not to use the lithotrite in an empty bladder. The thud, just mentioned, will easily be distinguished from the sharp click of fragments of stone, as they are drawn against the opening in the catheter by the out-rushing stream; this sound will cease as the fragments diminish. When débris cease to fall into the trap, the lithotrite is again used, the fragments reduced in size and evacuated as before, and so on alternately until no more stone can be felt or obtained.

In all these proceedings gentleness and care are necessary; the operator will change his lithotrites from a large and fenestrated one at first to a smaller and non-fenestrated one as the stone diminishes in bulk. The former never clogs; the latter pulverises fragments best, and renders their extraction easy and swift. Should the orifice of the urethra be too small to admit the evacuating tube which the size of the stone renders it proper to use, say 16 or 18, it may rightly be divided by a straight, narrow probe-ended knife for about half an inch alongside the preputial frænum. No other part of the urethra will oppose its passage, unless the prostate is awkwardly enlarged, and this will seldom obstruct it. It is desirable to remove the last fragment; and every experienced lithotritist knows how difficult this may be, for, after operating for some little time, these final small pieces are prone to get hidden in the recesses of the bladder, or to be enveloped in small clots of blood or thick mucus, and so escape detection. It is not right, however, to persevere or prolong the manipulation too much in searching for them. They will probably be expelled in a day or two, or they can easily be removed at a second sitting. So, too, although this method is called 'one sitting,' circumstances connected with the general condition of the patient or the state of the bladder may oblige the surgeon, however unwilling he may be, to desist and divide the treatment into two or more sittings.

At the termination of the operation the patient is warmly covered; hot dry flannels are applied to the perineum and above the pubes, and a morphia suppository placed in the rectum. Warm diluent drinks, such as barley-water or lemonade, are freely supplied, and a milk diet prescribed for a few days. Many patients are almost well at once and have no after-trouble whatever; others experience cystitis, more or less acute, and some require the catheter for a time to deal with retention. If much muco-purulent secretion accompanies this condition, or is present without retention and does not speedily abate, the bladder should be carefully washed out twice a day, or oftener, with warm boracic water or a weak solution of nitrate of silver. The strength of this solution will vary with each case; it is well to begin with a grain to three ounces of distilled water, but not infrequently as much as four to six grains to the ounce is beneficial. Rigors are proverbially common in all bladder cases requiring the use of instruments; frequently they simply mean a slight nervous shock, are evanescent, and do no harm. Sometimes they usher in cystitis; sometimes, too, they are the forerunners of grave, continued, and even fatal nephritis. Not infrequently, however, kidney-inflammation comes on without rigor, pain, or any bladder-complication. The patient becomes mildly febrile, complains of no pain, but he loses appetite and strength, fades away, and dies in the course of two or three weeks. The necropsy reveals pyelitis, dilated ureters, and hyperæmia, with or without scattered abscesses of the kidney.

Another complication, usually fatal, but happily rare after lithotrity, is suppression of urine. This may be looked for when the patient is known to have been subject to ordinary albuminuria; also in cases of chronic kidney-disease, the result of slow and slight inflammatory conditions. These cases are very difficult to diagnose beforehand. The urine probably contains no blood, albumen, or casts; there is no anæmia, and the patient looks, probably, in fair health. Suspicion may, however, be entertained if there be a large secretion of limpid urine, non-albuminous, but of low specific gravity. Should death from suppression occur after lithotrity or lithotomy, the necropsy may display no hyperæmia, but simply a contracted kidney, with atrophy of the tubular and cortical structure, or possibly a dilated pelvis, but still with wasting of the secreting tissue. Calculus in the kidney not very infrequently coexists with stone in the bladder; its presence would be suspected if there were persistent aching over one kidney, but as often as not there are no diagnostic signs, and its presence is only revealed after death, when it has led to some of the fatal symptoms above described.

Treatment has but little control over these formidable renal complications, when they arise after lithotrity. The prompt removal of all remains of stone, frequent washing of the bladder with antiseptic fluids if there be fœtid urine and muco-purulent deposit, perfect rest, good sustaining diet, rubefacient applications to the loins, quinine, and moderate use of opium in some form if absolutely requisite: these means may sometimes ward off the worst symptoms, and facilitate recovery.

The Old Method of Lithotrity may still be preferred in certain cases; it requires perhaps less skill than the new, and the young surgeon may therefore be well justified in preferring it. In ordinary cases there is but little difference in the results. Even in the most experienced hands, the mortality of the one-sitting method would appear to be only one to two per cent. less than the old method, and in inexperienced hands it would very likely be greater. The old plan is gentler, milder, less formidable altogether; no anæsthetic probably is required, no extra assistance; the surgeon calls by himself and makes a short sitting, just as much as the patient is willing to bear, or it may be that the patient even calls on the surgeon when only a fragment or two have to be dealt with. A nervous, timid patient may prefer this to the more heroic and rougher, if more expeditious, proceeding. The writer, although fully admitting the many advantages of the new operation for the large majority of cases, has yet allowed himself to follow the old lines occasionally, and he is not dissatisfied with the result.

The first sitting should be conducted with great care, the stone being taken up and broken only four or five times. The patient should remain in bed for at least a day or two, during which time he will void water while recumbent. Some little cystitis will probably ensue, but frequently the sharp pains of stone abate at once and before any of it is passed. In a few days the sitting will be repeated, and the surgeon will soon form an opinion as to how much instrumentation his patient can bear. If the expelling power of the bladder be deficient, or the prostate be enlarged, in all probability the passage o débris will be slow, and only the finest will escape. Under these circumstances, its removal should be secured either by the repeated use of the non-fenestrated lithotrite, sometimes six or eight, or even ten times, in as many minutes, at each sitting, by which a large quantity is soon withdrawn; or by the application of the evacuating catheter and aspirator at once. The number of sittings required will vary according to the size of the stone, and the facility and rapidity with which the fragments are voided. From three to six is the average; but the writer observes in his list of cases one of seventeen sittings for 360 grains, and another of twenty sittings for 384 grains of dried débris. Both these cases, however, would now undoubtedly be treated by the new method. The last fragment is still the difficulty, and it should be the surgeon's most anxious care, by searching and re-searching, with sound, or lithotrite, or evacuator, to secure its removal; he will narrowly watch the patient's sensations, and if any, the least, of the old feeling at the glans penis or at the prostate should persist, he will not allow him to return home so long as a doubt exists.

The after-treatment is the same in both kinds of operation, but this may be added. Sitting should follow sitting without unnecessary delay, probably within three or four days. After the first crushing, however, should mild cystitis occur, a few days or a week of rest and treatment may elapse; but if the condition shows a tendency to run on, especially if it be associated with fetid urine and febrile persistence, the sitting should be promptly repeated, and if possible the entire stone removed at once by the evacuator. Should the use of the lithotrite at or after the first sitting prove to be very difficult or ineffective, and the vesical tenesmus and constitutional disturbance very severe and unsafe, the surgeon will be justified in at once clearing the bladder and putting it at rest by lithotomy. The writer has never yet thought it necessary to adopt this alternative, but he is inclined to admit, on reflection, that, in a few cases, the patients might possibly have been saved by its timely performance.

Foreign bodies have occasionally to be removed from the bladder; they are of great variety, and may require either lithotomy or lithotrity. *See* Foreign Bodies in the Bladder.

The Obstacles met with in lithotrity may be due (1) to the size and nature of the stone; (2) to stricture of the urethra; (3) to enlarged prostate; (4) to atony of the bladder; (5) to sacculation of and other changes in the bladder.

(1) The mere weight and bulk of stone are no test of the difficulty of crushing. A stone weighing an ounce, composed of pure lithic acid, will, from its intense hardness, test the quality of the instrument and the strength of wrist more than one of double the weight, composed of phosphates or some of the salts of uric acid. The writer has sometimes trembled for his instruments when dealing with these pure red lithic stones; they break into sharp, angular pieces, very different from the laminated, smaller, fawn-coloured, and often multiple stones, composed of lithate of ammonia, which are, perhaps, in Norfolk at all events, the most common variety after the pure lithic. The oxalate of lime stone is also very hard, but it breaks into less angular pieces than the lithic. Litholapaxy, however, has accomplished the removal of lithic acid and oxalate of lime stones of two and even three ounces and upwards, and it may perhaps be said that, given a healthy bladder and prostate, a capacious urethra, and an experienced hand, the only limit as to size of stone is the power of the lithotrite.

(2) Stricture of the urethra, if slight and capable of full dilatation, need be no bar to lithotrity for stones of moderate dimensions; but in old stricture, with great surrounding induration and fistulæ, lithotomy will obtain the surest and most permanent cure. Sometimes a stone is detected in the urethra behind the stricture, as well as one or more in the bladder, or it may be partly in the bladder and partly in the urethra, and in these cases median lithotomy will not only remove the stone, but may go far to remedy the stricture by external division.

(3) Hypertrophy of the prostate gland is not necessarily a serious impediment to lithotrity; but, if it is considerable, it may impede the easy introduction of instruments, make the seizure of the stone difficult, the expulsion of débris slow and tedious, and in the one-sitting method obstruct the free and efficient action of the evacuator. Prostatic enlargement, also, leads to alterations in the shape and condition of the bladder, which deserve more attention with reference to lithotrity than they have hitherto received. Coming on as it usually does about or after the age of sixty, when the vital power begins to wane, it induces, by the obstacle it offers to the free escape of urine, dilatation and hypertrophy of the muscular walls of the bladder, and leads to imperfect contraction, residual urine, and,

worse than all, to sacculation of the mucous membrane in all its degrees. Enlargement of the median lobe, when it is considerable, projects backwards into the cavity of the bladder in such a manner as to form pouches or cornua on each side of it, and even below it, into which portions of stone may and do get, and where it is almost impossible for any instrument to follow and seize, or even detect them. Injections will not always wash them out of these recesses, especially when they are immersed in viscid adhesive mucus or blood-clot; they are probably overlooked, and may account for some of those numerous recurrences of stone which lithotritists have to lament.

(4) Atony of the bladder, from whatever cause, is a serious drawback to lithotrity, chiefly because, as the natural expulsive power is lost, the surgeon must trust to his instruments to remove the final, minute atoms of stone; and this is a matter of no small difficulty in flabby, reticulated, and irregularly-shaped bladders.

(5) Sacculation of the bladder is also an enemy to complete and permanent cure by lithotrity. The formation of these sacculi, from the slight honeycomb recesses between the hypertrophied columns to the complete sac, in which the mucous membrane is forced gradually between and through the muscular fibres and may equal the bladder in size, is well understood. The aperture of communication with these complete sacs is usually closed by the contraction of the muscular columns, so that a stone may be broken and none of the fragments may enter them; but, on the other hand, débris does sometimes find its way into them or one of them. The surgeon is unaware of it, and the patient, being relieved of nearly all his suffering, is probably declared to be cured. But trouble is in store for him: gradually an encysted stone is formed; it enlarges and grows up into the bladder; pain and cystitis return, and all the surgeon can do is, from time to time to break off and remove the projecting portion; or he may do lithotomy, with the slight hope of being able to dislodge the whole stone from its bed. Sacculation, too, may lead to another serious danger in lithotrity—viz. to peritonitis. In two fatal cases, the writer found after death acute peritonitis, apparently originating in large sacs, the walls of which consisted of mucous membrane only covered by peritoneum, and were in a sloughy condition; the inflammation was probably due to decomposing urine imprisoned in the sacs; the fœtid character of the urine was perhaps increased by the slight cystitis set up by the operation. In all cases of sacculation and stone, it is certain that the danger now pointed out would be diminished by the prompt and immediate removal of all the débris, and this constitutes another advantage of the one-sitting method.

The Dangers of Lithotrity are—(1) bleeding; (2) clogging of the lithotrite; (3) impaction of fragments in the urethra; (4) rupture of the bladder or urethra; (5) cystitis and nephritis.

(1) Bleeding is seldom a cause of trouble, but in a few recorded cases the bladder has become filled with clot and unable to relieve itself, and the patient has been brought into danger by both local and constitutional symptoms of a serious kind. In such a condition two courses are open for adoption —either to draw off the urine as it is secreted, by the frequent use of a full-sized catheter with a large eye, soothing the part and system, and leaving the clot to soften and come away by degrees; or the clot may be sucked out of the bladder by a strong syringe and a large catheter, alternately washing and exhausting until all is removed. The first method is generally preferable, but in either case troublesome cystitis is apt to follow.

(2) Extreme impaction of the lithotrite with débris can only occur with the non-fenestrated instrument; when it does happen, the operator should endeavour, by opening and closing the blades, and moving them about in the urine, to free them to some extent. Then he will try to withdraw the lithotrite: it will probably pass along the prostatic and membranous urethra, but it may be arrested either just behind or in front of the scrotum, and if by fair traction force it will not come away, it will be right to cut down on it in the perineum, turn out the blades and unload them, and then withdraw the instrument. If the opening in the urethra is far down in the perineum, it would be good practice to slip the finger back into the bladder, dilating the passage as it goes, and clear out all the stone as in a median lithotomy; or, if this is not done, a full-sized catheter should be introduced and retained in or near the bladder for a time, so that no fragments may pass until the wound is more or less closed, and if possible no urine should be allowed to irritate it. This accident has only once occurred to the writer, with one of Charrière's instruments. It was withdrawn with some force, causing slight laceration of the mucous membrane; swelling followed, fragments of stone accumulated at the part injured, and led to a sloughy abscess, which

was opened, and allowed all the stone to escape. The patient recovered, but a permanent fistula, close in front of the scrotum, remained. Even when the instrument is not over full, it is apt to scratch the urethral membrane with sharp fragments which project from the blades; it is seldom that this causes harm, but it is to be borne in mind as one of the disadvantages of the non-fenestrated lithotrite.

(3) Rupture of the bladder or urethra has undoubtedly occurred since the introduction of litholapaxy—of the bladder, presumably, by sudden over-distension, or by the point of the evacuating catheter; of the urethra, by the rough use of too large an instrument. Peritonitis in the one case, and urinary extravasation in the other, will befall the patient, and discredit will come upon the surgeon. It may be expected, however, that these mishaps will not be repeated now that the novelty of the operation has passed by.

(4) Arrest of fragments in the urethra occasionally occurs, and may produce total or partial retention of urine, pain, spasm, and distress. Very often, the natural efforts and pressure of the urine will accomplish the removal of the obstacle in a short time; if they do not, and the fragment is far back, it should be pushed into the bladder by a large catheter, open at the end so that it may better engage and hold the offending piece. When arrested nearer the meatus, it should be seized and withdrawn by long slender forceps or Civiale's urethral lithotrite. It is very seldom, indeed, that a fragment will require to be removed by external incision, but this may be called for.

(5) Ordinary cystitis and nephritis have been referred to already in describing the after-treatment; but there is a form of persistent chronic cystitis, accompanied with vesical irritability, decomposing urine, and phosphatic deposit, which all lithotritists admit to be not infrequently the sequence or consequence of the operation. It generally occurs in old and feeble persons in whom the prostate is hypertrophied, the bladder dilated and unable to empty itself, and therefore unable to expel all the débris of a broken stone. Hence, although by clearing out the main bulk of the stone the patient is greatly improved, some few atoms probably elude detection, and these, acting as nuclei, form the basis of future phosphatic concretions, and in a few months, or perhaps a year or two, the patient presents himself again and is again more or less cured. Sometimes the bladder, at this second intervention of the surgeon, is entirely freed of calculous matter, and by the careful use of the catheter and diligent washing out of the bladder no further recurrence takes place; but this happy result is rather the exception than the rule, and the surgeon must either go on repeatedly removing phosphatic matter with the lithotrite, or he must do lithotomy with the hope—the somewhat forlorn hope—that by entire clearance of stone, and by drainage and repose of the bladder for a time, a permanent cure may result. Some surgeons attribute this persistent chronic cystitis to the rough use of instruments, or to some inherent tendency to phosphatic deposit; but the writer believes that, in the great majority of such cases, it is due to leaving some trifling piece of stone undetected. The difficulty of finding and removing the last atom in some bladders has been alluded to. The hope has been expressed that by the aspirator and the large evacuating tube of the new method this may be more certainly accomplished than by the old method; but at present it is only a hope, and it is yet to be proved that recurrence of stone is less frequent now than it used to be. Stones of purely bladder origin and formation are rarely met with. In ordinary cases of atony and chronic cystitis, with decomposing urine loaded with muco-purulent deposit, stone will seldom occur unless there is a nucleus of some kind; and, when stone does occur in these cases, it will be found that they are almost always of renal origin, although the bulk of the stone may probably be composed of phosphates.

The Results of Lithotrity may, like those of lithotomy, be considered—(1) as to the mortality; (2) as to recurrence.

Taking again the experience of the Norwich Hospital, there have been 121 cases in 117 individuals with 13 deaths, being 1 in about 9½, or 10·7 per cent. The average age was just sixty, the average weight of stone preserved was 110 grains. In the 13 fatal cases the average weight of stone was 209 grains, showing that, as in lithotomy, the mortality increased with the increasing size of the stone.

The list of lithotrity cases recently reported by Sir H. Thompson affords, both from the large number and the brilliant success obtained, the best evidence of what lithotrity can achieve. He enumerates 672 cases in 576 adult males with 43 deaths, being 1 in 15½, or about 6 per cent. The average age was sixty; the weight of stone is not given, and this diminishes the interest and value of the record. He mentions, however, having crushed 100 stones which were so small as to produce only slight symptoms, and of which cases only one was fatal. In a valuable paper read by Sir H. Thompson at the International Medical Congress in 1881, he gives the weight of 75 cases done by Bigelow's method, the average being 130 grains, and in others the stone is described as 'small.'

Dr. Freyer, of the Indian Civil Service, has recently published (*Lancet*, February 28, 1885) a remarkable series of 108 cases in males above puberty, done by litholapaxy, with only 4 deaths, being 1 in 27 only, or 3·7 per cent.; the average age of the patients was forty-seven, and the average weight of stone 317 grains. Thus there were more young and probably healthy, and fewer old and probably unhealthy, persons than English lithotritists are accustomed to meet with; but the average size and weight of stones in Dr. Freyer's practice was undoubtedly great. The record indeed is the most remarkable and successful yet published, and testifies strongly to the skill of the operator as well as to the endurance of the Indian constitution.

Recurrence of Stone after Lithotrity is undoubtedly common; it constitutes the greatest drawback of the operation, and requires from the practical surgeon the most candid statement and the fullest inquiry. An analysis of Sir H. Thompson's cases would seem to show that of 576 adult males treated by lithotrity, 61 were operated on a second time, 9 a third time, 3 a fourth, and 2 a fifth time; or 75 out of 576, being 1 in 7·6, or 13 per cent. It is probable that not all who suffered from recurrence applied to him again; they may have gone elsewhere or declined further treatment. Moreover, there were 43 fatal cases, in none of which could recurrence have taken place. Further, this list of 75 only includes those which, Sir H. Thompson considered, deserve to be called 'stone,' and does not include those numerous ones of so-called phosphatic 'concretions,' which are due either to phosphatic deposit from decomposing urine in an incompetent bladder or to undetected fragments. If, therefore, this frequent recurrence of stone has occurred in the practice of one so skilful and of such vast experience, it must be admitted that, so far as it can be shown to be incident to the operation of lithotrity, it must be considered a great and serious drawback.

The causes of it are, as in lithotomy—(1) the descent of a fresh renal stone; and (2) the leaving of stones or fragments of stone at the first operation. The descent of a fresh stone from the kidney is obviously as likely to follow one operation as the other; there are not a few persons who are in the habit of voiding small stones composed of lithic acid or lithate of ammonia, and this habit may persist after some of these have been removed by operation. But when it is remembered that in lithotomy recurrence is almost certainly caused, in more than half the cases, by leaving stones or portions of stone at the first operation, and when it is remembered too that recurrence is vastly more frequent after lithotrity than after lithotomy, it cannot be denied that, in by far the larger number of cases of recurrence after lithotrity, the real true cause is the leaving of calculous débris in minute quantity at the first operation. The difficulty of removing these final atoms from the recesses and pockets of the atonic, half-paralysed bladders of aged and feeble persons has been referred to; the difficulty may, and probably will be, much lessened by the large evacuating tubes of Bigelow, but hitherto this drawback has been regarded as the price paid for the vastly greater security to life from lithotrity, as compared with lithotomy.

Choice of Operation.—This is a matter not infrequently of great nicety and difficulty, even to the most experienced surgeon. Indeed, as Sir W. Fergusson has said, the greater his experience, the greater will sometimes be his doubt. He will, in certain cases, dread, if he cannot clearly diagnose, those kidney-changes which may mar his best endeavours, and which the young surgeon is apt to think but little of; he will know, too, that even with a measuring sound it is not always safe to infer the exact size of a stone, for, in large, flattened stones, a small diameter may mislead him into the belief that he has one of a moderate size to deal with. There are some points, however, on which all surgeons are agreed. In children under puberty, unless the stone is very small indeed, lithotomy should be the rule; its good results in the young, and the small size of the urethra, which precludes the use of the evacuating tube, combine to favour the method of cure by one complete operation. On the other hand, in the healthy adult, lithotrity should undoubtedly be adopted in all cases where the stone is of moderate size; but it may be asked what is meant by the word 'moderate.' A different answer will be given now to that which used to be offered, for it is certain that litholapaxy is competent to deal with stones of considerable magnitude, even up to 2, 3, and 4 ounces. It should, however, be borne in mind that a single hard uric acid or oxalate of lime stone of 1½ or 2 oz. will be far more difficult to break and extract, and be more trying to the patient, than double that weight of small multiple or friable and laminated stones. Up to an ounce and a half in weight, there can be no doubt of the immense superiority of lithotrity over lithotomy, so far as mortality is concerned. Above that weight, say from 1½ to 3 ounces, it yet remains to be seen whether lithotrity by any method can be applied with more safety and success than lithotomy.

In the Norwich Hospital there have been 193 cases, chiefly adults, treated by lithotomy, in which the stones weighed 1 ounce and under 2, with 159 cures and 34 deaths, being 1 in 5·6, or 17·6 per cent.; and 55 cases of 2 ounces and under 3, with 35 cures and 20 deaths, being 1 in 2·75, or 36 per cent. These figures will serve as a basis for future comparison. In stones weighing more than three ounces the choice will rest between lateral and supra-pubic lithotomy; and here, again, experience, not at present forthcoming, is required to assist in deciding. In the same hospital there have been 50 cases, almost all done by the lateral method, of stones above 3 ounces, with 31 cures and 19 deaths, being 1 in 2·6, or 36 per cent. This list also will serve for future comparison. The writer has long felt that supra-pubic lithotomy deserves a full re-examination by the light of modern antiseptic surgery and the more perfect system of drainage; lately a fresh impetus has been given to this inquiry by the investigation of Professor Petersen. So that it would seem likely that in future, the time-honoured operation of lateral lithotomy will be shorn of its prestige and diminished in its supremacy by the extended domain of litholapaxy on the one hand, and of supra-pubic lithotomy on the other. In children of both sexes, with large stones, the high operation has been proved to have great advantages, and in adult females, when the stone is beyond the compass of lithotrity, the high operation will probably come to supplant the vaginal or any other method of cure.

These principles and rules dealing with stones of various sizes are applicable only or chiefly when the urinary organs are sound and the general health good; but what course should be adopted when these circumstances are adverse? The effect of stricture, of prostatic enlargement, of changes in the shape and walls of the bladder, have already been mentioned. Mere vesical irritability seldom impedes lithotrity, nor do atony and chronic cystitis; these bladders, as a rule, bear the contact of instruments well, and are frequently already accustomed to the constant use of the catheter. But what is to be said of stone, complicated with kidney disease, such as albuminuria, and chronic pyelitis, and atrophy? In these cases all operations are fraught with danger, but it is probable that the least risk will be met with from a carefully conducted one-sitting lithotrity. So, too, in those cases of constitutional disease combined with stone, such as diabetes, tabes, and other spinal diseases, it will be well to avoid the shock and hæmorrhage of lithotomy, and proceed, if any surgical proceeding is allowable, by lithotrity. This, however, can only be recommended in cases where the stone is of strictly moderate size; when it is of 1½ or 2 oz. and upwards, the lateral or high operation will probably afford the best of the bad chances of recovery. Some consideration in selecting the operation must be given to the tact and experience of the surgeon. A beginner will do well to adopt lithotomy in cases of full-sized stones in which his more experienced colleague would trust himself to do litholapaxy; but no one should adopt the latter without practising it well beforehand outside the bladder. Lastly, it may be said that by lithotomy there is greater danger to life, but a more perfect recovery for those who do recover; while by lithotrity the immediate security to life and the present recovery are not infrequently dearly purchased, and well-nigh counterbalanced, by the recurrence of the disease or the more or less permanent persistence of some form of vesical trouble.

William Cadge.

LITTRE'S OPERATION for opening the colon in the groin. *See* Atresia Ani.

LIVER, Rupture of the.—From its size the liver is more frequently ruptured than any of the other abdominal viscera. Either surface of the organ may be torn, but the upper is more frequently so affected, and an organ that is diseased is more prone to suffer than one of normal texture. Several degrees of rupture are met with, varying from a slight superficial crack to a complete pulp. The parenchymatous tissue may sometimes be torn while the peritoneal covering of the organ is left intact.

Causes.—Blows, falls, spent shot taking effect in the hepatic region, wheels of vehicles passing over the abdomen, fractured ribs perforating the diaphragm.

Symptoms.—As there are none that are strictly diagnostic, the presence of a communicating wound or the performance of laparotomy can alone lead to an accurate estimate. The precise nature of the injury and the region of the abdomen must be considered. Shock, if the rupture be of any extent, is well marked; the general surface of the body is pallid and cold; vomiting, thirst, general restlessness, sighing respirations and feeble pulse, are present; also pain and tenderness in the region of the liver; but this is likewise present when the organ is merely bruised. An increase in the faintness and feebleness of pulse denotes that the hæmorrhage is continuing, and that an accumulation is taking place in the peritoneal cavity, which will be recognised by a gradually widening area of dulness on percussion. If not speedily fatal, jaundice and itching of the skin may supervene. Should an external wound exist, bile may be discharged through it.

Prognosis.—This depends upon the size of the rupture. If it be of any magnitude, death takes place in a few hours from shock and hæmorrhage. Small ruptures may be recovered from, and very superficial cracks may pass undetected. If the immediate dangers be overcome, the subsequent ones that threaten are peritonitis and abscess due to the extravasation of blood and bile. When the serous covering of the organ is not torn, the chances of recovery are enhanced.

Treatment.—Rest in the horizontal position; warmth to the general surface of the body; hot fomentations or ice applied over the region of the liver. To relieve pain and tenderness, morphia should be administered subcutaneously or by suppository. Brandy, if it can be borne, should be administered by the mouth in frequent but small doses until the heat of the body is restored. To allay thirst, ice may be given to suck, and cold or warm water in teaspoonful doses.

If it be evident that the internal hæmorrhage is copious or continuing, the abdomen may be opened in the middle line between the ensiform cartilage and the umbilicus, the peritoneal cavity emptied of blood-clot or bile, and the wounded organ examined. Should exposure not restrain the hæmorrhage, the bleeding surface may be gently seared with the thermo-cautery; the abdominal cavity should then be washed out thoroughly with clean hot water and carefully dried with sponges. A glass drainage-tube having been inserted, the rest of the parietal wound should be closed and dry dressings applied, secured with strapping and a wide flannel bandage. The drainage-tube should be retained for at least twenty-four hours, and longer if the discharge be copious.

Peritonitis must be treated in the ordinary manner, and any abscess-formation should be evacuated by the aspirator or by incision. THOMAS F. CHAVASSE.

LOCAL ANÆSTHESIA.—When we consider the fatal cases which have resulted from general anæsthetics of all kinds, and call to mind the fact that very many of the deaths have occurred in operations of trifling magnitude; when also we think of the unpleasant and sometimes dangerous after-effects of such anæsthetics, it is obvious that local means for the prevention of pain would be of the greatest value.

Although by squeezing and rubbing the lobe of the ear jewellers render it insensitive to the passage of a needle, the use of compression of sensory nerves may be said to have failed to produce sufficient anæsthesia to render even small operations painless. Narcotic drugs—opium, morphia, belladonna, chloroform, carbonic and carbolic acids—applied to the unbroken skin or injected hypodermically, are either too weak in their action to prevent the pain of a cut, or they produce painful effects such as vesication. But lotions, ointments, and vapours of the above drugs are valuable when applied to painful ulcers, simple or malignant.

Until quite recently, the only local method of preventing the pain of an operation was that of freezing the part. This may be done by—(1) the application of a mixture of ice and salt to the part, or (2) by the ether spray.

Ice and Salt.—Finely powdered ice and salt, well mixed in the proportion of 2 to 1, and put into a gauze bag, are closely applied to the part. In five to ten minutes the skin becomes yellowish-white, firmer than natural, looks tallowy on section and does not bleed, and incisions into it are painless. After a somewhat longer application a nail may be painlessly removed; but it is impossible to freeze deeper tissues without great probability of inducing sloughing.

The *ether spray* is handier than ice and salt. The nozzle should be held one to two inches from the part. In from half to two minutes, a white firmish patch appears and rapidly spreads. Painless incisions may now be made in the skin; but the deeper parts are unaffected. It has been recommended to play on the latter through the incision—to make the spray precede the knife; but this is a very slow process, and could not be carried out for large incisions. The knife, too, gets crusted with ice, and the operator's fingers numb. No cautery or light must ever be brought near the spray. *See* ETHER-SPRAY.

The first objection to both these methods is that their action is very superficial. But they cannot be recommended even for superficial operations, as the sensations in a part during freezing are painful; and, during thawing, the suffering may be so acute as considerably to exceed that which the operation itself would have caused. It is well, however, to bear in mind that a Cæsarean section has been done almost painlessly under the ether spray.

Hydrochlorate of Cocaine.—During the last few months this drug has been much used as a local anæsthetic. A solution of from 4 to 20 p.c. is either dropped or painted over the surface to be anæsthetised, two or three times at intervals of three to five minutes; sufficient anæsthesia is thus produced for the performance of small operations, and continues from ten to fifteen minutes. But the drug will not act through unbroken skin, and can, therefore, be used as above only upon mucous surfaces. Two cases have, however, been reported in which a hypodermic injection rendered the opening of an abscess painless. The new anæsthetic has been used chiefly in operations upon the eye, ear, nose, mouth, larynx, urethra, and rectum. Its capabilities are probably not yet fully determined.

STANLEY BOYD.

LOCK-JAW. *See* TETANUS.

LOOSE CARTILAGE.—This is the name given to certain movable bodies, of varying origin and constitution, which are found in the interior of joints, especially the knee, and whose presence gives rise to a characteristic train of symptoms.

The name 'loose cartilage' is, however, not always an accurate one; for these bodies are sometimes not loose, and frequently contain no cartilage. Most often they consist chiefly of fibrous tissue, in which is a small quantity of ill-formed cartilage containing some irregularly deposited calcareous material. They may, however, be formed of true cartilage, or of cartilage which has undergone a variable amount of ossification or calcification. Others consist of small masses of fibrinous lymph.

They may be single or multiple, and they vary in size from a quarter of an inch to an inch or more in diameter. The majority of these bodies lie loose in the joint, and can travel to any part of it; but occasionally they are attached by a pedicle which limits their range of movement. Their occurrence is almost confined to the knee, but they have occasionally been met with in the elbow, and rarely in some of the other joints. Their mode of origin is variable, though they are often traced to injury. Probably, many of them occur in the early stages of osteo-arthritis, in which cartilaginous or calcareous material is formed in a synovial fringe, and this, becoming pendulous, is eventually detached either by injury or the movements of the joint. Or, they may have their origin in the exudation of inflammatory lymph upon the surface or into the substance of the loose synovial tissue; and this, undergoing development into fibrous tissue or cartilage, is separated from its attachment by the pressure of the bones. In other cases, a piece of the articular cartilage is detached either by direct injury or by the process of necrosis.

The *symptoms*, caused by the presence of a loose body in a joint, are recurrent attacks of pain and synovitis. The pain comes on suddenly and is very acute; it is due to the body slipping between the ends of the bones. In the knee (which is the only joint that need be considered), when this occurs the joint becomes immediately fixed, and this, together with the severe pain, often causes the patient to fall. After a time, usually a few hours, or it may be in the first effort to move, the loose body again becomes displaced and the joint can be moved; but more or less synovitis ensues. These attacks of pain and synovitis recur whenever the loose body becomes caught between the bones, and, as every attack of synovitis leaves the joint a little looser, this occurrence is apt to become increasingly frequent.

Treatment.—This must depend upon the amount of inconvenience caused by the presence of the loose cartilage, and also upon the condition of the health of the sufferer. In some cases, a carefully contrived splint or bandage will keep the offending body in the upper pouch of the synovial cavity, where it may possibly become fixed by adhesions. Or, the same end may be attained by the use of strapping over it a piece of leather, with a hole cut in it to receive the loose body. But usually such measures are inefficient, and the patient requires something more radical to be done. The only curative treatment is the removal of the loose body from the cavity of the joint. This, of course, can only be done by opening the joint, which, even with every precaution, is an operation of sufficient gravity to forbid its being undertaken till palliative measures have been tried. Moreover, it is to be remembered that any serious disturbance of the patient's health, and especially such as is indicated by the presence of albumen in the urine, should deter the surgeon from any avoidable operation upon a large joint. Nevertheless, if the local inconvenience renders the extraction of the loose cartilage desirable, and the patient be in good health, the operation may be undertaken with every prospect of success.

Two methods of operation are available: one in which an incision is made directly into the joint, and the loose body at once removed; the other in which, the capsule of the joint being opened subcutaneously by a long knife passed obliquely under the skin, the loose body is pressed out of the joint into the subcutaneous cellular tissue, and either left there or removed after the wound into the joint is healed. Whichever operation is adopted, the strictest antiseptic precautions should be observed; and, if due care be taken on this point, the removal of the loose body by direct incision is, in the writer's opinion, the preferable method.

If the loose body be freely movable, an incision a finger's breath in length should be made on the outer side of the joint, the loose body if possible being held in that position, and then squeezed through the opening. Should the substance slip away, as often happens, the finger may be introduced into the joint to bring it again towards the opening, through which it may be extracted by a small pair of lithotomy forceps. If there be any difficulty, it is much better to explore the joint with the finger than to search for it from the outside or by movements of the joint. The wound is to be closed by a fine catgut suture, antiseptic dressings applied, and the limb at once fixed on a splint.

Usually, there is no local or constitutional disturbance; the wound is healed in a few days, and after a fortnight's rest of the limb the patient may be considered well. Should there ensue any inflammation of the joint, it must at once be combated by decided antiphlogistic treatment.

J. Warrington Haward.

LORDOSIS. *See* Antero-posterior Spinal Curvature.

LUMBAR ABSCESS.—An abscess, usually chronic, situated in the loin or over the lower ribs near their angles.

Cause.—Generally due to caries either of the spine or ribs; may also come from deeper parts, as the kidney, or may have no evident source of origin; this last occurs usually in children, and is subcutaneous. In children, also, acute abscess in the erector spinæ, without bone-disease, is seen.

Pathology.—When from spinal caries, it may be a diverticulum in the course of a psoas abscess, starting at the upper or lower end of the primary abscess; and, when the former, it lies over the lower ribs, and may be mistaken for a localised empyema. Or pus may travel directly backwards from the spine to the outer edge of the erector spinæ; or, more rarely, may be over the spines themselves; or, passing between the laminæ, may get into the sheath of the erector spinæ; or a dorsal spinal abscess may travel down and become lumbar. Caries of the lower ribs or of the iliac crest may also cause lumbar abscess; and a pyonephrosis and perinephritic abscess may project in the loin, as well as in the abdomen.

Symptoms.—No special subjective symptom belongs to lumbar abscess; the tumour is generally the first thing remarked. Any source of origin, as above, must be sought for; the deep connection of the swelling is shown by a cough impulse.

Diagnosis.—The abscess is recognised by the usual physical signs; its origin must be discovered by history and examination. The possibility of its being part of a psoas abscess must not be forgotten. When over the lower ribs it may be an empyema, which an examination of the thorax will decide; or it may be from rib-caries. Until the abscess is opened, it is usually impossible to feel any carious or irregular surface. A local spot of pain under the abscess and in the rib suggests caries. The 'cold' subcutaneous abscess of children has only negative signs with regard to origin. Pyonephrosis and perinephritic abscess cause abdominal swelling as well, and probably pyuria. Renal cancer resembles lumbar abscess at times, but there is no true fluctuation; there are great pain and special renal symptoms—e.g. hæmaturia.

Treatment.—Whether due to caries or not, the abscess must be opened freely; this allows exploration and perhaps removal of sequestra. In the subcutaneous abscess of children, relief of tension by aspiration, followed by firm bandaging over belladonna plaster, with the internal use of iodide of iron, frequently causes resolution of the abscess.

C. Hilton Golding-Bird.

LUMBAR HERNIA.—In this variety of hernia, the protrusion presents itself externally in Petit's triangle. This triangle is bounded in front by the external oblique, and behind by the latissimus dorsi, while its base is formed by that part of the iliac crest which lies between the attachments of the two muscles. To reach the triangle, the hernial sac passes through the posterior aponeurosis of the transversalis muscle, and then through the fibres of the internal oblique. Its neck will be situated near the outer border of the quadratus lumborum. This rupture has occurred most usually after wounds, deep abscesses, and severe contusions. It is also said to have followed pregnancy and ascites. The sac may contain small intestine or omentum, or a portion of the ascending or of the descending colon. The hernial tumour is usually very small, but it may attain the size of an infant's head. It is reported to be usually oval in shape, with its long axis placed antero-posteriorly. Its orifice is large; and it is as a rule readily reduced. It may, however, become irreducible or inflamed. It has been the seat of strangulation, and in one reported case of strangulation herniotomy was performed, but with a fatal result. The hernia has been mistaken for lumbar abscess, for hæmatoma, and for a fatty or fibro-cellular growth.

Frederick Treves.

LUNG, Hernia of the. *See* Pneumocele.

LUNG, Inflammation of the. *See* Pneumonia, Traumatic.

LUNG, Wounds of the.—These may be produced in three ways—

(α) By an external agent, as in stabs.

(β) By the fractured end of a rib.

(γ) Certain rare cases occur in which the lung ruptures in compression of the chest, where no rib-fracture can be detected.

Wounds of the lung are also divided into punctured, lacerated, and incised wounds. Of these, the incised wounds are the most dangerous, being attended with the most copious hæmorrhage. A punctured wound is the least dangerous, as may be illustrated by the effect of an accidental puncture in exploration of the chest with the aspirating needle. A lacerated wound, such as that caused by a fractured bone, will be dangerous in proportion to the amount of tissue involved.

Diagnosis.—(*a*) Where there is an external wound, blood and bubbles of air may be seen in some cases escaping from the opening in the act of respiration, or even passing backwards and forwards by an efflux and reflux movement. If the wound in the chest be large, there may be a hernia of the wounded lung (pneumocele). In such cases (which are, however, rare), the diagnosis is easy, but in the majority a wounded lung must be diagnosed inferentially from the state of the chest and other symptoms. On account of its vascularity, hæmorrhage from a wound in the lung is one of its most common accompaniments. This takes place into the cavity of the pleura (hæmothorax), and into the lung-tissue about the site of the wound. Comparatively seldom does this hæmorrhage take place to any great extent externally, unless the wound be very large. The elasticity of the tissues, and consequent tendency of a small wound to close, will, as a rule, shut in the blood, and the hæmorrhage thus takes place internally. Internal hæmorrhage, whether into pleura or lung, gives rise to dulness about the affected side, more especially about the base of the lung, if the amount of extravasated blood be considerable. The area of dulness, however, depends a good deal upon the position which the patient assumes after the injury is inflicted. If, as is most common, it be the recumbent posture, the blood will not necessarily gravitate towards the base of the lung, and the area of dulness will be most marked about that part of the chest upon which the patient has principally lain.

The *amount* of blood extravasated is not generally great enough to cause any considerable compression of the lung, unless some very large vessel has been wounded; but it is often enough to separate completely the surfaces of the pleura. Fine crepitation is the auscultatory sound most commonly present. But if the amount of blood extravasated be large, the crepitation will disappear, and the breathing sounds become indistinct or inaudible from the lung-tissue having become compressed. The very rapid appearance of the dulness after the injury will enable the surgeon to distinguish it from acute pleuritic effusion.

Other signs of wounded lung consist in:—

1. A fixed, deep, and severe pain in the thorax about the region of the wound.

2. Much troublesome cough, with irritation of the larynx, causing constant desire to cough. The patient, however, is obliged to repress the tendency within the narrowest possible limits on account of the increase of pain so caused, and thus arises the peculiar, small, *suppressed* cough of thoracic injury.

3. Very considerable dyspnœa. This no doubt arises from, and is directly proportioned to, the amount of lung-tissue rendered inoperative by the injury.

4. Hæmoptysis. Frothy blood is coughed up from the chest into the mouth in this condition; at a later stage, as the pneumonic state supervenes, the frothy blood gradually gives place to rust-coloured sputum.

5. Pneumothorax. This condition is generally conjoined with more or less hæmothorax. Air passes, either from the wounded lung or from the external wound, into the cavity of the pleura; this causes resonance on percussion over the upper part of the pleural cavity, and dulness in the most dependent part; sometimes, but not invariably, the succussion sound is present. Comparatively seldom is there any general emphysema of the tissues, unless the external wound is very small, with a great tendency to close. As a rule, if there be extravasation of air beyond the bony parietes, it escapes from the wound, and does not accumulate in the subcutaneous tissues.

(β) When the wound in the lung is produced by the fractured end of a rib, the symptoms are more limited in number. In addition to those of the fracture, there will probably be expectoration of frothy pale-red blood at first, and after two or three days rust-coloured sputum. This will be accompanied by troublesome cough, deep-seated thoracic pain, some dyspnœa, and probably a considerable elevation of temperature. There may be more or less hæmothorax, or more rarely hæmopneumothorax. Pneumothorax is not, however, so frequent after this injury as when there is an external wound. On the other hand, its place is taken by the much more frequent occurrence of a general emphysema of the cellular tissue of the parietes, and this is more frequent in the young and healthy than in the aged. Its occurrence must definitely show that not only has there been some rent in the pulmonary surface, but that the pleura costalis has also been torn through. The air must therefore pass across the cavity of the pleura before it can extravasate into the areolar tissue of the parietes. It is a remarkable fact that, under these circumstances, the cavity of the pleura but rarely fills up with air and the explanation probably is that after the lung has been lacerated, swelling of its substance very rapidly takes place, on account of its great vascularity and the hæmorrhage which consequently takes place into its parenchyma, so that the lung fully occupies the cavity in which it is contained. Consequently, the wound in the lung becomes applied to the corresponding part in the pleura costalis in which the rent has occurred, and any air which may extravasate is forced out through the wound into the general areolar tissue of the parietes at each expiration, there being no room for it in the pleural cavity.

(γ) Wound of the lung or rupture of this viscus from simple compression of the thorax, without any fracture of the ribs, is of comparatively rare occurrence. It is only likely to take place in young persons, where the ribs and sternum are very elastic. In the case of a young lad under the writer's care, there was, in addition to bloody expectoration, a limited patch of emphysema towards the root of the neck, as if air had been forced out of the rent of the lung and through the dome of the pleura in the direction of least resistance, by the violent squeeze which the chest had sustained. In this case, also, was present the peculiar capillary venous ecchymosis which often accompanies violent compression of the chest. It principally affected the parts where the skin was thinnest and the capillary blood-supply most abundant. Thus, the whole of the conjunctivæ were suffused of a pinkish tint, the whole of the skin of the face was covered with minute bluish dots, which gave it *en masse* a livid tint. The skin of the neck was also deeply affected, but less than the conjunctivæ and face. This boy ultimately recovered, the emphysema disappearing in three or four days, the capillary ecchymosis not for nearly a fortnight.

Prognosis.—This must mainly depend upon the *depth* and *size* of the wound in the lung. Small wounds are rarely dangerous; large wounds, especially those involving a large vessel, are exceedingly so.

Treatment.—The patient should be placed in bed in the most easy position; this will generally be lying over on the injured side, so as to allow the escape of blood or discharge from the wound, and to permit the freest movements of the uninjured side in respiration. No attempt at any deep examination of the wound should be made with the probe or the finger—though in cases where the hæmorrhage into the pleural cavity is considerable, a drainage-tube will be of some value. Nor is it wise to attempt the washing-out of the wound with any antiseptic lotion, when first seen. The *surface* of the wound may be washed over with some carbolic lotion (1 to 40), and then covered with protective and antiseptic gauze. The whole should then be surrounded with a bandage of moderate tightness. The tight bandaging formerly recommended is not generally borne well by patients in this state, on account of its interfering too much with the freedom of respiration. Nor is the object for which it was devised—viz. the checking of the bleeding and the prevention of extravasation of air—easily attained by this means. The bandage, then, should be of only moderate tightness, and applied more for the purpose of immobilising the wounded side of the thorax and supporting it, than for the purpose of compressing the chest. Although these wounds can rarely be rendered aseptic from the first, it is an advantage to dress them under the carbolic spray. The dressings should be changed every day or every other day in accordance with their condition. If the wound is healthily granulating, dressing on alternate days, or even less frequently, will suffice; but if there be any putridity, or much discharge, it should be made daily. If a drainage-tube has been used for very extensive pleural hæmorrhage and consequent threatened collapse of the lung, it should be withdrawn at the earliest practicable moment when equilibrium seems to have been re-established in the chest. If retained too long, it will tend to favour the entry of air and the formation of a pneumothorax.

As medicinal treatment, small doses of vinum antimoniale (♏x.), with two or three drops of tinct. opii in some liq. ammon. acetatis, are useful for checking the tendency to pneumonia, and for allaying the cough. The amount of food given during the first two or three days should be very small. The tendency to hæmorrhage may be checked by reducing the amount within the narrowest possible limits, and the writer has several times kept these patients upon only half a pint of milk for the first three or four days, with the most excellent results. A very small quantity of ice may be allowed with it to check urgent thirst. After the first four days, the amount of fluid food may be slightly increased, but it is always better in such cases to err on the side of starvation than the reverse. H. G. Howse.

LUPUS ERYTHEMATOSUS.—*Definition.*—A hyperæmia of the skin, mainly affecting the sebaceous glands and hair-follicles, and accompanied by a cell-growth. It appears in the form of one or more red, slightly raised patches, chiefly on the face, is extremely chronic, and ends, without ulceration, in atrophy and superficial scar.

Etiology.—The cause is still obscure. In certain persons, with feeble circulation and a tendency to chilblains, it seems to be provoked by comparatively slight irritating causes, such as sunburn, exposure to cold, sea air, and wind. Rich and poor are equally liable to its attacks, but females more than males. It is a rare form of lupus, and neither hereditary nor contagious.

Symptoms.—The disease may begin at any age, but usually does so between fifteen and thirty, and often lasts for life. It commences with one or more well-defined oval or round erythematous patches on the face. These gradually spread and coalesce, forming, when fully developed, what is known as the butterfly outline, the body resting on the nose and a wing extended on either cheek. Occasionally it commences on the scalp, but it is constantly symmetrical wherever located. The usual order of appearance is primarily on the nose, extending thence first to one cheek and then to the other, then to the ears, scalp, backs of hands and fingers, feet and toes, and trunk, affecting each side to an equal extent. In colour it is either of a bright red, dull brick red, or violet tint. The crust that forms on the patch, and is an important feature of the disease, varies in colour, being sometimes grey, but often yellow; and the plugs of sebaceous matter extending into the follicles render it very adherent to the skin. As the patches extend, their centres become gradually converted into thin, superficial, silvery-tinted scars. If the active process be suspended, the scarring may spread over the whole of the patches. Sometimes, even after a long period of quiescence, from some slight or scarcely apparent cause, the patches may increase in size. The edge of a well-defined patch is raised, while the centre is depressed, and, when the crust is forcibly removed, the surface is found to be red and pitted, and covered with numerous bleeding points. The mucous membrane of the lips is occasionally involved; but, speaking generally, the mucous membranes are not attacked as they are by lupus vulgaris. The whole process terminates in absorption, and there is never any ulceration. Even in cases in which large tracts of skin are affected, the general health is not usually interrupted, except in the acute and severe variety described by Kaposi, Hans Hebra, and others in Germany, in which the appearance of the eruption is accompanied by fever, often terminating in death. In ordinary cases, some smarting or burning is experienced on exposure to cold or heat, or from indigestion, but there is little or no pain.

Diagnosis.—In an early stage it is apt to be confounded with simple erythema; but, as erythema is a transitory disease, a little time will suffice to show its true nature. From eczema it can be distinguished by the absence of watery exudation, by its chronic course, and, in the later stages, by the scarring; and from acne rosacea by its raised and well-defined margin, and the absence of pustules and tubercles. Syphilis will at times imitate lupus erythematosus in such a way as to make the diagnosis far from easy, but it is of value to note that this manifestation of syphilis is usually a late one, more rapid in its course, and not so strictly symmetrical as lupus erythematosus; besides which there is the important test by anti-syphilitic drugs.

Morbid Anatomy.—At first there is dilatation of the capillary plexuses of the sebaceous glands and hair-follicles, followed by a gradual development of a small-celled growth in the surrounding connective tissue. The crusts are formed of sebaceous matter. The new growth is converted into scar-tissue by a process of fatty degeneration. According to some authorities, the sweat-glands may be primarily affected.

Treatment.—A. *Local.*—There are three distinct indications in the local treatment: (1) Soothing and astringent applications to allay smarting or burning; (2) stimulating applications to promote absorption; (3) mechanical or chemical means for the destruction of the new growth. (1) When the erythema is the chief symptom, much may be done by avoiding all sources of irritation, such as cold wind, sea air, or sun, and by the use of cooling and astringent applications, such as liq. plumbi in lotion or ointment, oleate of zinc in powder or mixed with spermaceti ointment in the proportion of ʒj. to ℥j.; calamine ʒj., oxide of zinc ʒss., glycerine fʒiss., in rose water f℥vj.; cod-liver oil, liquor carbonis deterg. fʒss. to vaseline ʒj. Complete removal of all crusts should be effected by oiling and washing with soap and water, or, better still, with soft soap and spirits of wine in equal parts. (2) Stimulating applications of various kinds may then be employed, with a view to the absorption of the new growth. Mercurial ointments, sulphur, carbolic acid, chromic acid, chrysophanic acid, pyrogallic acid, iodine, iodoform, tar, salicylic acid, chloride of zinc, in various combinations and proportions, are all recommended, and are often of service in individual cases. (3) For the destruction of the new growth there is no method so efficacious as multiple linear scarification, repeated at intervals of a week for a long period. It is successful in about half the cases, and leaves a white, soft, yielding scar. The other methods of destruction are electrolysis, galvano-cautery, scraping with a sharp spoon; or by the application of caustics, such as chloride of zinc, or Vienna paste, or the acid nitrate of mercury.

B. *Constitutional.*—Cases have been recorded, from time to time, in which benefit and even cure has resulted from the prolonged use of one of the following drugs: arsenic, iodine, iodide of potassium, iodide of starch, phosphorus, and cod-liver oil. It is difficult to give any rule for constitutional treatment further than that any deviation from health should be treated, and that one or more of the above-mentioned remedies should be tried.

Malcolm Morris.

LUPUS VULGARIS.—*Definition.*—Lupus vulgaris is a chronic disease of the skin or mucous membrane, and consists of a cellular new growth in the substance of the corium, presenting the appearance of yellowish nodules of irregular size. After passing through various stages, it terminates in scars, the result of ulceration or atrophy.

Etiology.—Lupus vulgaris is less common in Great Britain and the United States than on the continent of Europe. It is said chiefly to attack people who live in cold, damp districts, and females rather than males. It is a disease of early life, making its appearance usually between the second and tenth year, but it is neither hereditary nor syphilitic. Until quite recent years, it was held by all authorities to be a manifestation of scrofula, but now that scrofula may fairly be considered to be a pathological process totally distinct from tuberculosis, the question arises whether lupus can be so classified. At the same time it is clear that certain changes in the skin resembling lupus are scrofulous in origin, but these, which should be classed under scrofuloderma, will be considered under the head of diagnosis. Whether lupus is or is not a local tuberculosis of the skin is a question of grave importance, bearing as it does directly on prognosis and treatment. Upwards of twenty years ago Mr. Hutchinson pointed out its connection with the tubercular diathesis; yet we find that out of 209 cases carefully examined by Dr. Raudnitz of Prague, although 21 cases are recorded in which there was hereditary history of tuberculosis, only 2 of them had lung-tuberculosis themselves. More recently, numerous observers have examined lupus-nodules for micro-organisms. Before Koch's discovery of the tubercle bacillus, Schüller described a microbe in the smaller tubercles of lupus, and Friedländer, Pfeiffer, Doutrelepont, Demme, Krause, Martin, Besnier, have all discovered bacilli in lupus tissue, and each has asserted the identity of lupus and tuberculosis. Schüller injected lupus into the trachea of animals, making at the same time a wound in the knee-joint, and after a certain time found tuberculosis of the lungs and the joint. Martin, using the same method, was once unsuccessful and once successful. Besnier quotes cases in which death took place from tuberculosis of internal organs in people suffering from lupus, and argues therefrom that lupus is a local tuberculosis, and may become the focus of infection of the whole body.

On the other hand, Kaposi, Vidal, and Kiener have, by different modes, subcutaneously inoculated various animals with lupus products, with only negative results. Cornil and Leloir, also, examined skin from eleven lupus patients but found bacilli in one case only. With this evidence before us, therefore, the whole question of the relation of lupus to tuberculosis must be considered as still *sub judice*.

Symptoms.—Lupus first appears in the form of a small, light-brown, or amber-coloured patch on the skin, with more or less redness round it. When pressed with the finger the redness disappears, but the patch itself, though rendered paler, retains its characteristic yellow tint. This peculiar appearance has been compared to apple jelly, and very aptly, for were a small portion of skin gouged out, the cavity filled with apple jelly, and the surface pared even with the surrounding skin, the resemblance to a primary nodule of lupus vulgaris would be complete.

When first this amber-coloured or 'apple jelly'-like nodule makes its appearance on the surface of the skin, it may be no larger than a pin's head, in which condition it may remain stationary for months or years, and then either gradually disappear, leaving in its place a small scar, or slowly enlarge. Again, there may be several of these primary nodules, which may coalesce, forming patches of irregular shape, when the rapidity of the spread of the disease will be found to be in proportion to the number of the nodules, the centre of each of which becomes gradually converted into scar tissue. The whole process is destructive, but the amount of destruction depends on the position of the nodules. When superficially placed in the corium, the resulting scar is thin and oftentimes barely visible; but, if deeply situated, the ulceration is more extensive and the scar unsightly. Though lupus vulgaris is primarily a disease of the skin or mucous membrane, it may also attack the subcutaneous tissue, muscles, cartilage, and all tissues except bone. There is, as a rule, little or no pain, and the glands in the neighbourhood of the diseased skin are usually not affected. Occasionally there is much erythema or œdema.

The different varieties of lupus depend either on the shape of the patch or on the changes it undergoes, but it cannot be too strongly stated that these are stages merely, and not separate varieties; and, as some or all of them may occur at the same time in the same individual, it would be better if the term lupus vulgaris were employed to designate all stages of the disease.

Lupus *exedens* or lupus *exulcerans* are terms applied to the disease when there is distinct ulceration, a phase usually confined to the nose or cheeks; lupus *non-exedens* when there is no ulceration. When the nodules shrivel and disappear with more or less desquamation, but without ulceration, the variety is termed lupus *exfoliativus* or *exfoliaceus*; while the huddling together of the nodules, so that they project considerably above the level of the skin, is called lupus *hypertrophicus* or *tuberculatus*. Should a patch of irregular outline be formed by the fusion of two or more patches, lupus *serpiginosus* is produced; but if it present the appearance of numerous scattered isolated points it is called lupus *disseminatus*. McCall Anderson adds yet another variety which, because of certain warty growths appearing on the tubercles, he calls lupus *verrucosus*, but which Vidal designated lupus *sclèreux*.

Lupus usually shows itself first on the skin of the nose, and the parts subject to attack next in frequency are the cheeks, and then the extremities. Next in order are the ears, mouth, gums, pharynx and larynx, eye, and female genital organs. The scalp is seldom attacked primarily. The disease on each part will now be briefly noticed, and its differential diagnosis, distinguishing it from certain other diseases, given.

Lupus of the Nose.—At first, in most cases, one or more small yellowish-red spots appear on the skin near the tip or at the sides of the nose. When these early nodules occur in the first decade of life, they are easily distinguishable from simple inflammatory diseases; from eczema by the absence of moisture and persistence, and from psoriasis by the immunity of other parts of the body and by the absence of the silvery scales. Their resemblance to true scrofulous nodules renders the diagnosis in an early stage less easy. The scrofulous nodules are harder when pricked, paler, and more raised than lupus. They are usually more rapid in growth and tend to ulcerate more quickly, and, as a rule, the neighbouring lymphatics are involved. When the first appearance occurs during the second decade, at or soon after the age of puberty, the lupus nodules are apt to be mistaken for either acne vulgaris or a secondary manifestation of syphilis. The lupus nodules are, however, usually larger than acne, not limited to sebaceous glands, not pustular, soft when pricked, and are of longer standing. They are distinguished from syphilitic nodules by the absence of the cachexia, enlarged glands, sore-throat, and the mixed eruption usual in that disease. Lupus of the nose is sometimes difficult to diagnose from acne rosacea. The age at which the disease showed itself, the presence of apple-jelly nodules and scarring, are the guides.

Lupus of the Cheeks.—Lupus vulgaris is a non-symmetrical disease; it is, therefore, not uncommon to see on one cheek a single patch that has lasted for years, or both cheeks may be attacked by extension from one side, or as a result of several nodules scattered on the nose and cheeks. It is interesting to notice that, however much the disease may extend, the forehead and chin, as a rule, escape attack. Diagnosis of a single patch of lupus is not always easy, but it will be discernible from eczema, psoriasis, and acne rosacea for reasons already mentioned. Lupus may be distinguished from scrofuloderma by its hardness, and the frequency with which it appears in scars after abscesses. Enlargement of the glands and other signs of scrofula, such as catarrh, serve to distinguish scrofula from true lupus. Tertiary tubercular syphilide may be recognised by the age at which the disease first appeared, by the rate of its growth, by the shape and colour of the patch, and by the history and presence of old scars. When attacking both cheeks and nose and not ulcerating, lupus vulgaris may be confounded with lupus erythematosus, which may be distinguished from it by its symmetrical distribution, by the age at which it appears—usually after puberty—by its superficial character and its total freedom from ulceration, by the absence of apple-jelly tubercles, by the colour and nature of the crusts, and the plugs on the under surface when removed.

There is a variety of lupus vulgaris, occasionally seen on the face, which often ulcerates, leaving small pits, and which, from its resemblance to common acne, has been called *acne-lupus*. The chief features of chronic ulcerating lupus of the face, which may be mistaken for simple scrofulous ulceration, epithelioma, rodent ulcer, and tertiary syphilis, are the age of the patient, the mode of origin, the rate of growth, the character of the ulcer, and the constitutional effects. Both lupus and scrofula commence in early life, the latter in a hard tubercular nodule which breaks down speedily, forming an ulcer with a thin undermined edge; the surface is either devoid of granulations or covered with pale flabby granulations which bleed easily, and the surrounding skin purple or red. The lymphatic glands are enlarged, and there are usually other signs of scrofula. There are nodules of lupus around the lupus ulcer, the edges of which are not well defined. The discharge is yellowish but not offensive, forming thick scabs, and there is a tendency to heal in the centre. Epithelioma and rodent ulcer usually commence in middle or late life, and generally at the junction of skin and mucous membrane, as, for instance, the margin of nostril or eyelid; and usually from one point, and not several, as in lupus, and the process is very slow, as a rule lasting for years. They differ from lupus in their tendency to destroy deep tissues, including bone, and by showing no disposition to heal. The rodent ulcer is cavernous, the base smooth, and the edge firm and inelastic. The syphilitic ulcer spreads serpiginously, often with an outline of a horse-shoe shape, unlike lupus; in addition to which the edges are sharply defined, the discharge is foul, and there is a tendency to destroy deep tissues, including bone. Its rate of growth is usually more rapid than that of rodent ulcer or epithelioma, and the existence of early symptoms of syphilis and the presence of scars are important data.

Lupus of the face, by destruction of the skin and scar-contraction, may produce the most terrible deformity. Ectropion and dragging of the mouth and nose are common results, as also loss of a great portion of the nose.

Lupus of the Ear.—The ear may be attacked either primarily or by extension from the face. The disease may commence on the membrana tympani and spread outwards, or on the outer ear and ultimately involve the membrane, from which cause deafness frequently results. The destruction and deformity are also at times very great, leaving the external meatus permanently contracted.

Lupus of the Trunk and Extremities.—Lupus may attack any part of the surface, and differs in appearance according to the part attacked. It may start and pursue its course in the same way as on the face, though as a rule the process is even slower. There is a variety, most severe in character, which has been described under the name of *lupus mutilans*, which attacks the fingers and toes, ulcerating greatly, and causing much destruction, contraction, and deformity.

Lupus of the Mucous Membranes.—This may either commence in the mucous membrane or may spread thereto from affected skin. When primarily affecting the mucous membrane it is difficult to recognise, and there is little doubt that it has often existed long prior to its discovery. The nasal mucous membrane is that most commonly attacked, next the mouth and pharynx, and occasionally the larynx, while the rarest parts are the genital organs, both male and female.

In the nose, the first indication is a scab or crust and a slight sensation of soreness. If the scab be removed the exposed surface bleeds easily, is sensitive to the touch, and soft when scraped. If not arrested at this stage deep ulceration may ensue, often causing the complete destruction of the cartilaginous septum. In the mouth, isolated patches may occur on the lips, which become swollen and everted, on the gums and on the hard and soft palate. The tongue is rarely affected. The conjunctiva is seldom attacked primarily, but occasionally by extension from the cheeks.

Morbid Anatomy.—Sections of skin affected with lupus vulgaris show under the microscope small scattered nodules, arranged like nests in the fibrous connective tissue, composed of young cells situated in a highly vascular network. The surrounding corium is at first free, but gradually the small-celled growth extends along the vessels, or the sweat-glands, or the hair-follicles and sebaceous glands, until the whole depth of the corium is involved. The epidermis, at first unaffected, becomes hypertrophied. Fatty degeneration and absorption may take place in the deeper nodules without destruction of the epidermis, or ulceration of the whole substance of skin and subcutaneous tissues may result, followed by cicatrisation.

Treatment.—A. *Local.*—Whatever method is used, the ultimate aim in the treatment of lupus is the total destruction of all the existing lupus tissue. This is not an easy matter, even when the parts are well within the surgeon's reach. Each method has its advantages and disadvantages, and care must be taken to select that most suitable to the individual case. When there is much erythema or œdema in the neighbourhood of the patch, soothing or astringent applications, such as lead or zinc, are for the time preferable to violent caustic or surgical treatment.

The points of most importance, in selecting a method to destroy the growth, are the thoroughness of the destruction and the kind of scar produced by the process.

The various means may be divided thus:—1. Mechanical. 2. Chemical.

1. *Mechanical.*—When the disease is situated on the face and is superficial, much improvement, and often cure, can be effected by free scarification. By this process only diseased tissue is destroyed. If the parts be more deeply involved, scraping, with one of the many kinds of curette or spoon, is often attended with the most satisfactory results. In all forms of ulcerating lupus, and in lupus of the mucous membranes, scraping is to be preferred to any other treatment. The scraping, to be effective, must be done thoroughly and repeated constantly, so as to destroy every vestige of the new growth. In disseminated lupus, a narrow curved spoon may be introduced into a nodule and pushed subcutaneously into a neighbouring one, when both nodules can be broken up by rotating the spoon. The writer has introduced a double screw for the complete destruction of small isolated nodules.

The actual cautery is strongly advocated by some, and at times excellent results are obtained by its use. For this purpose Paquelin's thermo-cautère is the best way of applying it. A fine point, heated to redness, should be firmly inserted into each nodule until the resistance of the sound tissue is felt. Care must be taken not to operate on too large an area at one time.

The ultimate scar is not so satisfactory as that attendant on scraping, as much thick cicatricial tissue often results; but it is a suitable method of treatment for isolated nodules which have resisted other treatment. The galvanic cautery is strongly recommended by Dr. Besnier of Paris, because it destroys without blood-letting. Occasionally, it is useful to combine scraping and cautery, first scraping out as much of the diseased tissue as possible, and then lightly cauterising the raw surface. Weak solutions of perchloride of mercury, chloride of zinc, carbolic acid or boracic acid, or finely-powdered iodoform, are suitable dressings after either scraping or cautery.

2. *Chemical.*—The local treatment of lupus by chemical means alone must be looked upon as a somewhat obsolete method. Many have been recommended, but none are really satisfactory. In superficial cases, no doubt, some caustics are useful, but in consequence of the difficulty in regulating their action, they either destroy too much or too little. If strong acids are employed, such as nitric, more tissue may be destroyed than is necessary; or if weaker caustics are used, such as nitrate of silver, a solution of potassa fusa, carbolic acid, or arsenic paste, the diseased tissue may be only partly destroyed, and the remainder stimulated to renewed action. Injections into the nodules, by means of a small syringe, of a caustic solution, such as iodine 1 part, glycerine 20 parts, have been successful in the hands of Schiff of Vienna and others.

B. *Constitutional.*—It is difficult to lay down any rigid rules for guidance. It is doubtful whether there is a drug that has any specific power in preventing the formation or development of true lupus vulgaris. Lupus usually occurs in healthy people, but if there be any deviation from health it should, of course, receive attention.

Some authorities strongly advise the administration of such drugs as iodine, iodide of potassium, phosphorus, arsenic, iron, cod-liver oil; and, as no harm can accrue, it is wise to give the patient the benefit of a trial of one or more of them, at the same time impressing the opinion that without active local treatment the chance of cure is remote, if not impossible.

MALCOLM MORRIS.

LYMPHADENITIS or ADENITIS.

These terms are applied to inflammations of a lymphatic gland. There are many varieties of the process, and the cases may be divided into such as are acute, subacute, or chronic. The more useful and more usual division of adenitis, however, is based upon the nature of the morbid process involved, and is a division of the forms of the malady according to their kind rather than their degree. By this arrangement three principal varieties are separated: 1. The simple, 2. The scrofulous or tubercular, 3. The syphilitic. Besides these there are other specific forms, among which may be mentioned the adenitis met with in farcy, in the plague, in erysipelas, pyæmia, &c. The present article is concerned only with simple adenitis. The other forms will be found described under BUBO; GLANDERS; SCROFULA; SYPHILIS, &c.

SIMPLE ADENITIS, BUBO.—*Pathology.*—The inflammatory process when it involves a gland differs in no way from a like process attacking other parts of the body. It may assume an acute, subacute, or chronic character. In acute cases the gland is swollen, and is softer and moister than usual; on section it is red and often presents hæmorrhagic patches. The change is first observed and remains most marked in the cortex of the gland; all the blood-vessels are dilated, and the lymph-channels are blocked with leucocytes, among which will be found a few red blood-corpuscles. In the follicles also the number of lymphoid corpuscles is greatly increased; as the cells accumulate at any one part, that part becomes paler and the hyperæmia diminishes. The fibres of the reticulum become swollen and soften, and after a while break down, and the anatomical details of a large portion of the gland are lost. In the least severe cases resolution follows. The leucocytes undergo fatty degeneration and are absorbed, the congestion diminishes, and the gland becomes flaccid. In other cases—taking them in order of severity—suppuration takes place, either in isolated spots or throughout the substance of the disordered gland. This pus will probably be discharged, but, in cases that become chronic, its fluid parts may be absorbed and it may form a caseous mass in the centre of a disorganised and inactive gland. If the tension within the capsule has been considerable during the acute stage, the blood-vessels may become so compressed that the gland-tissue perishes, in whole or part, by necrosis. When the capsule is divided, it is found to be occupied by a sloughy mass. In another series of cases the inflammation becomes chronic. The congestion diminishes, and the gland becomes the seat of an extensive growth of new connective tissue. This tissue is of low organisation and ill-formed. It may develop into fibrous tissue and the gland be converted into an indurated mass composed mainly of this structure (cirrhosis or fibroid induration), or the newly formed material may break down here and there, and small collections of pus be formed, which will probably find their way to the surface from time to time.

Thus, an acutely inflamed gland may undergo resolution, or may suppurate or perish by necrosis, or may pass into the condition of chronic inflammation or long-abiding suppuration. It may become converted into a more or less permanent fibroid mass. It may caseate and in time become calcareous. It may undergo resolution, and after that may atrophy more or less completely. After having been once inflamed, it may at future times become again and again inflamed upon slight provocation, or, after having been quiescent for months or years, suppuration may be excited in it with singular ease. Such suppuration will take place about the residues of the primary inflammation, and will constitute the form of abscess termed by Paget 'residual.'

Causes.—Adenitis is nearly always secondary, and due to the absorption of morbid material from a focus of inflammation at the periphery. The lymphatics conveying that material to the gland may or may not be inflamed themselves. Adenitis may follow upon wounds, especially upon such as are septic or are irritated by the presence of a foreign substance. It occurs especially, also, in cases where pus has not a free vent, as in small sores covered with a scab. It is often seen after wounds exposed to continued irritation, as after abrasion of the heel from friction of a shoe. It would appear that, in rare cases, glands have been inflamed by the absorption of animal poisons through the skin, the integument presenting no breach of surface. Glands may be inflamed by direct violence; as an example of this, may be cited the case of a healthy man whose cervical glands became acutely inflamed after an accident in which the neck had been severely compressed. It is possible also that adenitis may sometimes be excited directly by exposure to cold. Inflammation in the vicinity of a gland may spread to that body by direct continuity of tissue, without of necessity reaching it by means of the lymphatics. Some individuals are more liable to adenitis than others. It is more common in the young; it is comparatively rare in the aged. It is often met with in those who are debilitated, as, for example, in children convalescent from fevers. The inflammation in the glands will partake of the character of the primary inflammation. It is indeed, a mere reproduction of it. The mischief in nearly every instance stops at the first chain of glands above the seat of the primary mischief. In some rare cases the inflammatory irritant is passed on, but always in a much modified and milder form, to the chain of glands next above those the seat of the adenitis.

Symptoms.—The gland becomes swollen, painful, and tender. It is at first movable, but soon becomes fixed. This latter symptom depends partly upon the increased size of the gland, partly upon inflammation which is usually excited in the connective tissue around the gland (peri-adenitis). The pain is lancinating and, as suppuration appears, throbbing. It is made worse by movement, and is somewhat relieved by relaxation of the part. As the disease advances, the skin becomes stretched, red, glazed, and frequently œdematous. Fluctuation appears in the centre of the indurated mass, and suppuration is evident. In time the pus finds an escape upon the surface. One gland alone may be affected, but, as a rule, others in the series become enlarged, not simultaneously but consecutively. In any case, one gland is usually more extensively involved than any other. Much of the pus is probably derived from the connective tissue around the gland. If this tissue be lax, the abscess may attain considerable size and the skin become in consequence greatly undermined. If many glands are involved, there may be lymph-œdema in the parts from whence their afferent vessels are derived.

The process, especially when suppuration occurs, is attended by a varying amount of constitutional disturbance. There may be a rigor, there is pyrexia with its accompanying symptoms, and sometimes much prostration. Adenitis of deeply seated glands, as a rule, causes more severe disturbance and more pain than adenitis of a superficial gland. This depends upon the confined position of the deeper gland and the tension that the inflammatory swelling produces. The writer has seen most severe symptoms attend adenitis of the small gland that lies in contact with the septum crurale. When the gland is surrounded by lax connective tissue, an extensive abscess may form without producing any marked constitutional disturbance. The possible modes of ending of a case of adenitis have been already indicated in speaking of the pathology.

In the *diagnosis* of the acute affection there can be little difficulty. The position of the swelling in the site of well-known glands; the probable evidence of an exciting cause and of a connecting lymphangitis; the circumscribed nature of the swelling and the probable enlargement of other glands in its vicinity, all tend to point to a precise diagnosis. The indolent and chronic enlargements are not always so easy to recognise. In the inguinal region, for example, they have been mistaken for irreducible femoral epiploceles and for solid growths of various kinds. In the diagnosis the position of the swelling should be noted, its circumscribed character, the fact that it can be more or less isolated, the probable presence of slighter gland enlargements in the vicinity, the tenderness of the swelling, the history of an exciting cause and, possibly, of a subacute initial attack.

Treatment.—In the first place, the primary cause of the trouble (wound, abrasion, ulcer, abscess, &c.) should be sought for and so treated as to encourage its healthy healing. With regard to the adenitis, rest of the part must be at once secured, and the limb put in such a position as to relax all the fascial tissues about the seat of the disease. Thus, when the groin is involved the patient should seek the recumbent position, and keep the thigh a little flexed by placing a pillow beneath the knee. To the gland itself an ice-bag should be applied. If applied early, it gives relief and appears to prevent suppuration. A degree of cold less than that of the temperature of ice appears to do harm rather than good, and to increase the pain. In some cases, when ice cannot be borne, the local application of extract of belladonna with equal parts of glycerine will give immediate relief, with or without a fomentation or poultice. Warm applications relieve, probably by relaxing the parts and by lessening tension, but they certainly appear to encourage suppuration. When the presence of pus is evident, it should be evacuated at once. The incision should be free, in the long axis of the tumour, and almost as extensive as the abscess-cavity. On no account should the pus be squeezed out of the cut; it should be allowed to escape of itself. Squeezing the part merely damages the fine lining membrane of the abscess, where such exists, and breaks up the softened and inflamed gland-tissue. Immediately after the incision a poultice should be applied. In twenty-four hours, if all the pus has escaped, the cavity may be syringed out with a 1 in 20 solution of carbolic acid, and, after a few more days of poulticing, it may then be dressed from the bottom. The little sac should be gently filled with lint soaked in glycerine and carbolic acid (1 in 20), or with gauze well powdered with iodoform.

The method of treatment by a small incision and a drainage-tube often leads to very tardy healing. Sometimes the pus is mainly in the connective tissue about the gland, and when the abscess is opened the inflamed lymphatic body may be seen exposed at the bottom of it. Such a gland should be removed. It can be taken away by a few touches with the thermo-cautery. If left, it is apt to lead to serious trouble and to greatly retard the closing of the cavity. When the healing is sluggish the part may be dressed with carbolic acid and glycerine in the proportion of 1 in 10, or with a solution of nitrate of silver (15 grs. to the ounce), or touched daily with a solid piece of sulphate of copper. When the skin is much undermined about a sinus, the integument should be divided so far as the undermining extends, and the cavity thus exposed dressed from the bottom. If the purple skin at the edge of such a sinus be greatly thinned, it may be destroyed with the thermo-cautery. When extensive chronic sinuses result from adenitis, they require active treatment. When possible they should be slit up, the unhealthy granulations which line them should be scraped away with a Volkmann's spoon, and the resulting cavity dressed from the bottom with some stimulating application. Sinuses that are too deep to be slit up should be scraped, and then dilated fully by the use of a sea-tangle tent. When this has been done they may then be dressed from the bottom. Sometimes the sinus depends upon the presence, at the bottom of the wound, of a fragment of a degenerating gland. The softened tissue of such a gland should be scraped away with a Volkmann's spoon, or be destroyed with the cautery. After both proceedings a drainage-tube should be used for a while. *See* SINUSES.

In dealing with chronic and obstinate sinuses, it is most important that the part be kept at rest. This precaution is usually neglected in the case of cervical sinuses, and the chronicity of these depends, the writer thinks, largely upon the constant movements of the neck. In such cases the parts should be fixed by a simple stock of guttapercha, fashioned to the neck and taking its fixed points at the lower jaw and the upper part of the chest. The writer has used such stocks extensively, and has found them well borne by the patient and of extraordinary value in many obstinate cases.

In very chronic, indolent gland-enlargements without breach in the integument, much can be done by attending to the general health, by change of air, by sea-bathing, and by the use of tonics, especially of iron. The simplest local treatment consists in the rubbing into the part, night and morning, of a little of the Ung. plumbi iodidi. This should be rubbed in for five minutes, and until the skin is a little red. This treatment is more certain and more efficacious than the painting of the part with iodine, which may, however, be tried if the ointment fails. In certain cases the gland resists all such treatment; it remains enlarged, is painless and perfectly quiescent. Such swellings may, for a while at least, be left alone. If, for any reason, their removal seems needed and they are solitary and well isolated, they may be excised, although the cases where excision is suitable are very few. If the indolent gland remains tender, and is still enlarging very slowly and is fixed in the tissues, it probably contains some suppurating foci in its interior. It is then best treated by thrusting the finest point of the thermo-cautery through the skin into the gland, and by passing the point in several directions through the gland without enlarging the skin-puncture. A drainage-tube should be finally introduced, and the part poulticed. By this means a gland which has long given trouble can often be got rid of, without leaving any but the slightest scar.

FREDERICK TREVES.

LYMPHADENOMA.—The primary non-inflammatory tumours of lymphatic glands have been subjected to many classifications, are still surrounded by an atmosphere of pathological doubt, and are burdened with a confused nomenclature. Under the term lymphadenoma may be comprised four kinds of new growth, viz.: 1. Simple Lymphoma; 2. Non-Leukæmic Lymphadenoma; 3. Leukæmic Lymphadenoma; 4. True Sarcoma. To each of these different tumours the term lymphadenoma has been applied by one author or another.

The above division includes all the primary non-inflammatory growths to which the lymph-glands are liable.

1. SIMPLE LYMPHOMA.—In this affection a gland enlarges without visible cause. By slow and gradual degrees it forms a tumour, that may be the size of a hen's egg or even larger. It is accompanied by no inflammatory symptoms, by no pain, by no tenderness. It contracts no adhesions. It is smooth and rounded, firm but elastic. It is usually found in the neck. As a rule only one gland is involved, but one or even two other glands in the vicinity may be affected. It does not affect the patient's health. It is a purely local affection, and does not recur after removal. It is associated with no constitutional defect. It shows, on section, a simple homogeneous aspect, and is composed of a new growth having precisely the structure of the follicles of a normal gland. It is difficult to decide whether the tumour is a neoplasm or a mere hypertrophy. In any case it is an innocent growth.

2. NON-LEUKÆMIC LYMPHADENOMA.—This disease is also known as Hodgkin's disease, adenia, pseudo-leukæmia, malignant lymphoma, and by the misleading term 'lympho-sarcoma.' In this form certain glands become enlarged without apparent cause, they increase in size, the disease spreads from gland to gland until a whole chain is involved. The tumours formed appear as large, round, smooth masses made up of clusters of enlarged glands. The disease usually begins in the neck, sometimes in the inguinal or axillary glands, and rarely in those in the interior of the body. In time, nearly all the more conspicuous glands in the body may be affected.

Etiology.—The causes of this disease are quite unknown. It is unconnected with scrofula, syphilis, or inflammation, It is somewhat more common in the delicate. It is three times more common in males than in females. Most of the cases occur between the ages of 25 and 35, and next in frequency between the ages of 5 and 12; it is rare after 45.

Symptoms.—The tumours increase without inflammatory symptoms, are not tender, and are not painful unless they grow quickly. They form smooth, prominent, bossy tumours which do not contract adhesions and which remain well encapsuled. Pyrexia is rare. The patients become debilitated and anæmic; they emaciate and lose their appetite. Profuse diarrhœa and dropsy are not infrequently observed, and the sufferer dies usually of exhaustion. Pressure symptoms may be produced. Gland-tumours in the neck may cause laryngeal troubles and dysphagia, sympathetic paralysis, and congestion of the great cervical veins. Tumours in the thorax may press on the trachea or lung or gullet, or may interfere with the action of the heart. Those in the abdomen may press upon the portal vein or bile-duct, and produce dropsy or jaundice. Masses in the groins or armpits may cause œdema of the corresponding limbs. Secondary deposits may develop in the alimentary canal, the liver, the kidneys, the medulla of the bones. The spleen is usually conspicuously affected, but it is important to note that there is no leukæmia. Death follows, on an average, in twelve months. The disease may end fatally in six months, or the patient may survive two or even three years.

The gland tumours are distinguished from those of scrofula by their wider distribution, their enlargement without visible cause, and the absence of inflammation. They form larger masses than are met with in struma, they do not suppurate nor become adherent to the skin, and they are usually not tender. They are not benefited by a treatment which would probably greatly influence scrofulous swellings.

Pathology.—The tumours are of two kinds, the soft and the hard. The former are quite soft and juicy, and homogeneous on section. The latter are firm, are also homogeneous, and yield but little juice. Transition forms between the two varieties are found. Microscopically, both kinds of tumour are composed of a tissue precisely resembling that of a normal lymph-follicle. The mass, indeed, is so like a gland that is composed wholly of follicles. The secondary deposits have the same character. The hard lymphadenoma differs from the soft in one particular only, its cell-elements are not so numerous, while the development of the reticulum and fibrous parts of the gland is peculiarly conspicuous. Clinically, the two forms are precisely alike and adopt the same course. The only differences consist in the different physical characters of the two forms of tumour, and in the fact that the hard lymphadenoma forms somewhat smaller masses.

3. LEUKÆMIC LYMPHADENOMA. — This disease resembles in nearly all respects, both clinically and pathologically, the affection just described as soft non-leukæmic lymphadenoma. Microscopically the tumours have precisely the same structure, and the appearance of the growths and the characters of the secondary deposits are practically the same in the two affections. Indeed, it may be said that there are only two main points of difference between these closely allied disorders. In the present disease the spleen is more conspicuously affected, and is implicated at an earlier period, while the blood presents the evidences of leukæmia.

It will be seen that, microscopically, these three forms of lymphatic gland-tumour are almost identical. The differences which some pathologists have maintained to exist between them are ill-marked and questionable. Indeed, it would be very difficult to differentiate these three forms by the microscope alone, provided that the examination were limited to the tumours. All these growths would appear to represent grades or degrees of one common affection. Why in one case the disease should remain an innocent local affection, while in another it assumes malignant characters, and in a third produces leukæmia, must remain at present a pathological mystery.

4. TRUE SARCOMA.—In rare instances sarcoma has appeared in a lymphatic gland as a primary tumour. Examples of round-celled, of spindle-celled, and of alveolar sarcoma have been met with in this situation. The growth commences in the connective-tissue reticulum or in the tissue around the vessels. The tumours differ in no way from sarcomatous growths appearing elsewhere. They may be distinguished from the other lymphadenomata by the following features:—Only one tumour is formed; it remains limited, for a long time at least, to one set of glands; it tends to invade the adjacent parts and to protrude through the skin. There is no leukæmia, nor the debility which is an early symptom in lymphadenoma.

Treatment.—1. In the treatment of simple lymphoma no measure is of any avail short of extirpation of the tumour with the knife. Medical treatment will neither retard the growth of the neoplasm, nor diminish its proportions when it is fully formed. Excision is easily performed, and the tumour has no tendency to recur.

2. In Hodgkin's disease surgical treatment is of little or no avail. Excision, to be of any service, must be performed at the very commencement of the malady, and, unfortunately, when the tumours first appear their precise nature is difficult to diagnose. By the time that the nature of the malady is beyond doubt, the case is probably beyond any surgical treatment. The benefit that has been obtained from a free extirpation of the growths has been temporary only, and has been purchased at a great immediate risk to life. When one definite tumour is causing troublesome symptoms from pressure, its removal may give the patient much relief. When the neck is involved and there is some risk of laryngeal stenosis from pressure, it is well to perform tracheotomy before the growth is so extensive as to hide the trachea. Local treatment of the growths by iodine, counter-irritants, setons, caustics, injections into the substance of the mass, electrolysis and subcutaneous crushing of the gland, is useless

when not actually harmful. The patient should be placed under the most favourable hygienic conditions. Cod-liver oil should be administered, and in every case iron. This may be given in the form of the sulphate or the perchloride, and, when these forms are not well borne, trial may be made of the hypophosphite or of Parrish's chemical food, or of Easton's syrup or Bravais' iron. Much good often attends the use of the syrup of the iodide of iron. The iron should be given with quinine or with nux vomica. In some cases, especially when the patient's health is still fairly good, benefit has followed the administration of iodide of potassium in increasing doses (from 5 grains three times a day to 20 or 30 grains). Many physicians strongly recommend arsenic. It should be given in increasing doses, until at last 20 or 30 minims of Fowler's solution are taken every day.

3. In leukæmic lymphadenoma any surgical interference is distinctly counter-indicated. The treatment of the case is the treatment of a case of leukæmia.

4. The treatment of sarcoma of lymphatic glands differs in no way from the treatment of that growth when attacking other superficial parts. *See* SARCOMA.

FREDERICK TREVES.

LYMPHANGIECTASIS and LYMPHANGIOMA.—The lymphatic vessels are liable to the same species of dilatation and the same kind of varix that are met with in the blood-vessels. They may present conditions that have their counterpart in nævus, in varicose veins, and in arterial varix or cirsoid aneurism. To the lesser degrees the term 'lymphangiectasis' is applied, to the more pronounced the term 'lymphangioma.' In the milder forms—as seen in the surface lymphatics—the vessels are dilated and tortuous. The dilatation is usually unequal. Ampullæ are apt to form, especially in the vicinity of the valves, and to appear under the thinned integument as minute vesicles. The dilated vessels themselves, moreover, can be both seen and felt beneath the skin, which is apt to become atrophied over them.

When the smallest vessels are most involved, distinct networks of varicose lymphatics may be formed (Reticular L.), but when the larger trunks are attacked, a series of long tortuous tubes only is to be seen (Tubular L.). In some cases of tubular lymphangiectasis the varicosity may be considerable, and, in one reported instance, the inguinal lymphatics were so dilated as to be mistaken for a hernial protrusion.

In certain instances the lymphangiectasis is congenital. In others it has followed upon occlusion of some lymphatics after lymphangitis. In another series of cases one may assume that the dilatation has been produced by conditions resembling those that cause varicose veins. The condition is more common in tropical countries than in Europe or in colder climates. The parts most often attacked are the lower limb, the scrotum, and the lower half of the abdomen.

Lymphangiectasis is often associated with solid œdema of the parts concerned, and with some local malnutrition. The little vesicular ampullæ are apt to rupture, and to lead to a troublesome lymphorrhœa. These dilated vessels, moreover, are frequently the seat of lymphangitis.

The *treatment* of lymphangiectasis is purely palliative, The parts should be protected from pressure and injury, should be kept raised when possible, and should be supported by slight elastic pressure.

In lymphangioma vessels of good size are involved. They are extremely dilated, and form large ampullæ, and cavities of the most varied shapes. Adjacent cavities are apt to break into one another, until a mass of intercommunicating cavernous spaces and passages are formed, all lined with endothelium. The condition is identical with that known in the blood vascular system as cavernous angioma, and is therefore usually termed lymphangioma cavernosum. This condition is probably always congenital. It underlies many hypertrophic conditions, such as macroglossia, macrochelia, and certain forms of elephantiasis, and is said by some to be the actual cause of congenital hydrocele of the neck. It is, moreover, very generally acknowledged to be the anatomical basis of certain forms of 'giant growth' in the lower limb. In some instances the lymphangioma has assumed the form of an isolated cystic tumour, and has, when in this condition, been incised, under the impression that it was a chronic abscess.

Such isolated tumours have been excised with success. Omitting these exceptional tumours, the treatment of lymphangioma cannot be considered apart from the conditions of tissue to which it leads, such as macroglossia, giant-growth, and the like.

A lymphangioma may involve the channels of a lymph-gland, and a large cystic tumour be in consequence produced. To such growths the term lymphadenectasis has been applied. FREDERICK TREVES.

LYMPHANGITIS, or ANGIOLEUCITIS.—These terms are applied to an inflammation of the lymphatic vessels. The inflammatory process is not necessarily limited to the lymphatics. Indeed, in nearly every instance of lymphangitis there is a visible implication of the corresponding glands. In the milder forms this implication may, however, be so slight that its effects may not be perceptible. The terms are conveniently applied to cases where the inflammation of the lymph-vessels is conspicuous, and is—for a time at least—predominant.

Causes.—Lymphangitis is in almost every instance secondary. Some irritative process is excited among certain lymph-radicles; an inflammation follows, which runs along the lymphatic vessels. The primary lesion is usually inflammatory, and depends upon a wound, stab, prick, or abrasion, or upon some ulceration or purulent collection. Lymphangitis has, however, followed upon simple sprain, and even upon long-continued or rough friction of the skin. Cases of sunburn—especially when involving the forearm—are often associated with quite an extensive lymphangitis of slight degree. The larger lymphatic vessels may be involved by the direct spreading to their walls of some inflammatory process in their vicinity. Some individuals are much more liable to lymphangitis than others, and especially those who are in feeble health, or who are the subjects of Bright's disease, or who have been debilitated by alcoholism. The disease is more common during youth and adult life than during childhood and in old age. The local exciting cause may be very trivial—a slight scratch, a minute puncture, the sting of an insect. In many cases it has probably been overlooked, and the lymphatic trouble regarded as primary. Lymphangitis is especially apt to occur when the body has been inoculated with decomposing animal matter (*see* POISONED WOUNDS). It is often met with, therefore, in medical men, in those engaged in dissecting, in butchers, cooks, &c. In suppurative affections, it is most commonly met with in cases where pus is closely retained. It is more likely to attend a minute abscess of the finger, where a bead of pus is retained, than the large suppurating surface of an amputation flap. There are certain forms of lymphangitis due to specific poisons, as illustrated by those attending erysipelas, malignant pustule, glanders, pyæmia, &c.

Pathology.—The inflammation most conspicuously involves the outer coat of the vessel, and the mischief is peculiarly apt to spread to the adjacent connective tissue. The intima becomes opaque, and its epithelium degenerates.

The contents of the inflamed vessel are no longer clear. They often appear fatty, or even puriform. Sometimes the contained lymph coagulates, and the vessel becomes plugged. In slight cases complete resolution follows, the vessels remaining a little dilated for a while. In a severer grade of the disease, the walls of the lymphatics remain greatly thickened, the adjacent connective tissue is sclerosed, and the lumen of the tubes is narrowed or obliterated. The coagula—when they exist—may become organised, or may break down into a pus-like matter. In the severest cases of lymphangitis, the walls of the lymph-vessels and the connective tissue outside those walls suppurate, pus fills the interior of the lymphatics, and the involved parts may slough, or at least undergo extensive destruction. Suppurative lymphangitis is often the starting-point for a severe and wide-spread inflammation of the cellular tissue. *See* CELLULITIS.

Symptoms.—To take a typical case. Let it be supposed that a man has an abrasion upon his knuckle, which becomes infected with some putrid matter. For one or two days nothing takes place, then about the wound an extensive red areola appears. This is due to implication of the primary lymphatic network (reticular lymphangitis). From this areola lines are soon to be seen running up the forearm to the gland above the inner condyle, and towards those in the axilla. These lines are of a faint pink, are sometimes straight, sometimes wavy, and always very narrow (tubular lymphangitis). They soon become painful on pressure, palpable to the touch, and usually in time form perceptible cords, while the redness over them becomes more diffused and less distinct. One or more glands will now be distinctly enlarged and tender, and, with the development of the glandular inflammation, the inflamed lymphatics will become less conspicuous. The affected parts of the limb are hot, and the seat of a burning or throbbing pain. If many lymph-vessels are involved, œdema will appear as a result of the blocking of the lymphatic channels. The disease may be ushered in with a rigor. There is a good deal of pyrexia, a feeling of malaise, and a certain amount of prostration. At the end of a few days or a week the inflammation subsides, and the parts are restored to their normal condition. As a rule, the œdema, when it exists, is slow to disappear, and usually the adenitis persists for a while, and often runs on to suppuration. In other cases the areola around the wound may be very slight: there may be little reticular lymphangitis. There may be tracks of tissue free from all evidences of disease between the wound and the inflamed lymph-canals, or between this tubular lymphangitis and the enlarged glands. The trouble may pass on to suppuration. This may spread, and involve extensive tracts of the subcutaneous cellular tissue. More frequently the suppuration occurs in the glands, and in either case the condition may lead to septicæmia or pyæmia.

When the deep lymphatics of a part are involved, the redness may be absent or present only in patches. The pain will be very severe, and the part very tender. There will be much swelling, which will be more or less diffused. When suppuration occurs in these cases, a very grave cellulitis may ensue. In any case the lymph-vessels may become occluded, some lymph-œdema may persist, and the part become brawny and hypertrophied.

The prognosis in lymphangitis is good. The only risk to life depends upon the suppuration, and death may ensue from any of the fatal issues that may attend suppuration. Other things being equal, it may be said that the nearer the lymph-disturbance is to the periphery, the less grave is the morbid condition,

Treatment.—The primary cause of the lymphangitis should be sought for and carefully treated. Any collections of pus at the primary focus should be freely opened, and, after having been well washed with a solution of carbolic acid or corrosive sublimate, the part should be treated with a charcoal poultice. The freest vent must always be given to the pus. Unhealthy wounds should be cleansed in the same way, and then dressed with iodoform powder, or poulticed if they are sloughy and not suppurating freely. To simply abraded surfaces evaporating lead lotion may be applied. The affected part must be kept at rest. If a limb be involved it should be raised. No application seems to better suit the parts—the actual seat of a lymphangitis—than an evaporating lead and spirit lotion, or the free application of belladonna. Any severe tension, and any suppurative focus, should at once be relieved by free incision; and at some hospitals the practice obtains of still applying cold after the matter has been evacuated.

Quinine should be given, and to this drug perchloride of iron may be added in a few days. Any swellings that may persist will probably be relieved by position, by friction or *massage* of the parts, or by the continued application of the elastic bandage. FREDERICK TREVES.

LYMPHOMA. *See* LYMPHADENOMA.

LYMPHORRHŒA or LYMPHORRHAGIA.—These terms are employed to denote an escape of lymph upon the surface of the body through an abnormal opening in a lymphatic vessel. In almost every wound lymphatics must be cut and lymph escape. The fluid, however, being translucent and very trifling in amount, and mixed at the same time with blood, is not perceived. The flow of lymph from a wound, moreover, would appear to very soon cease. In wounds of large lymphatic trunks, as in a punctured wound of the groin, where no blood-vessel of any size has been pricked, the escape of lymph may be sufficiently copious and sufficiently long-continued to attract attention. Instances, however, of this occurrence are exceedingly rare. In lymphorrhœa the discharge of lymph is very copious. It comes away in drops, and many ounces, and even several pounds, may escape in the course of twenty-four hours. It is probable that in every case there is some abnormality or disease of the lymphatic system. The state of the lymph-vessels may be similar to that of the blood-vessels in hæmophilia, or there may be some obstruction in the tube above the seat of the fistulous opening. With regard to this latter point, it may be noted that lacteals have been found ruptured after closure of some of the main vessels by the pressure of a tumour; and immense quantities of chyle and lymph have been thus poured into the peritoneal cavity. In by far the greater number of the cases of lymphorrhœa the involved vessels are dilated or varicose (*see* LYMPHANGIECTASIS), and, indeed, comparatively few cases of lymphorrhœa have been reported where this condition of the vessels has not been apparent. Lymphorrhœa has occurred after wounds, after slight operations such as venesection, after the opening of abscesses, and after incisions into inflamed and enlarged glands. It has occurred also from the surface of an ulcer.

In many cases varicose lymph-vessels have ruptured spontaneously, or have been cut into—when very large—under an erroneous impression as to their nature. Lymphorrhœa has followed the spontaneous bursting of a gland-abscess, and of small purulent collections the result of suppurative lymphangitis. The condition has been most frequently met with in the lower limb, and especially in the groin or thigh. The lymph escapes drop by drop, in the form of a clear, colourless fluid, which may sometimes have a faint yellowish or reddish tint, and occasionally an opalescent appearance. It usually flows more freely during movement and when the patient is standing. It varies in quantity from time to time without apparent reason. In certain instances as much as five pounds is said to have escaped in twenty-four hours. More usually, the amount escaping in a day would be a matter of ounces. The fluid coagulates into a flimsy clot, and hangs from the wound like a whitish fungus. In one or two instances of lymphorrhœa from the scrotum or groin the escaping fluid has been milky, and in these cases some abnormal communication with the lacteals or the thoracic duct has been assumed.

Lymphorrhœa only affects the health when it is profuse and long-abiding. When due to wound and involving a normal vessel, the discharge very soon ceases. When, however, the vessels are dilated or varicose, and when the abnormal opening has formed spontaneously, a very troublesome fistula is apt to be left, which may become more or less permanent.

In *treating* these cases, the limb should be raised and the part placed at rest. The skin should be kept cool, and the extremity compressed by an elastic bandage lightly applied. The fistula may be induced to close by long-continued pressure, applied by means of a truss or a pad and bandage; or, failing this, its margin may be touched from time to time with the actual cautery. Beyond this little can be done, and any attempt at a plastic procedure would probably end in failure. The patient's strength should be supported by tonics and a liberal diet. FREDERICK TREVES.

LYMPHO-SARCOMA. *See* LYMPHADENOMA.

LYMPH-SCROTUM. *See* ELEPHANTIASIS ARABUM.

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